GAS

MANAGEMENT ISSUE

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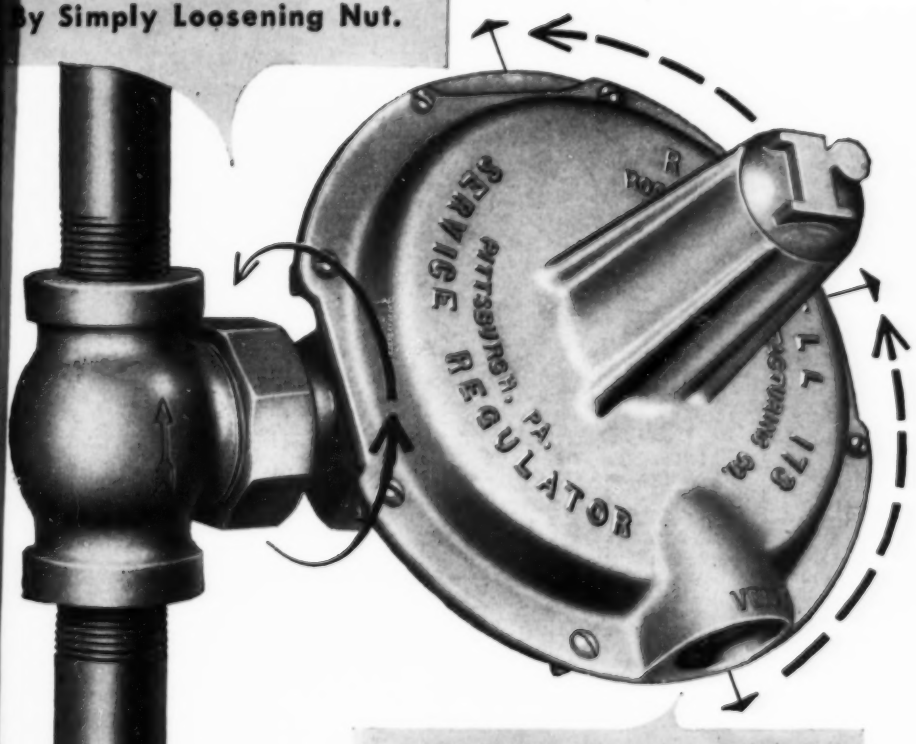

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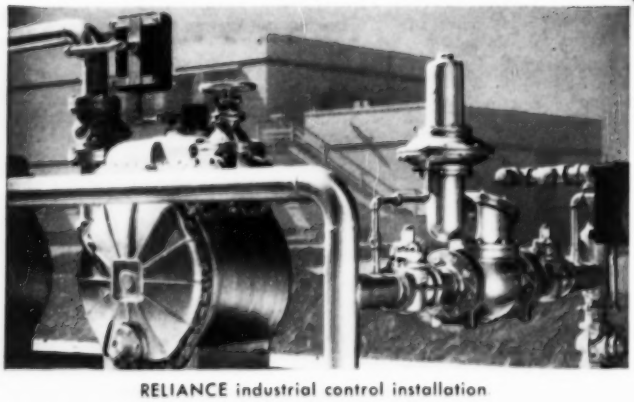

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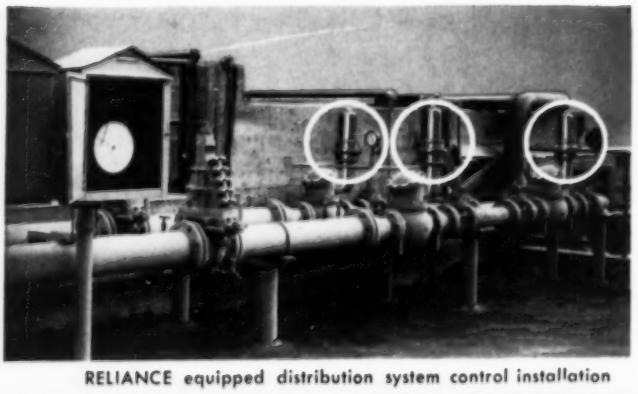

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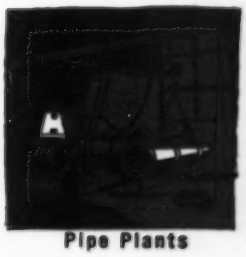
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GAS

31ST YEAR OF PUBLICATION

IN THIS ISSUE....

Pipeline and distribution management has a new tool for solving design and operating problems—the digital computer. But much of the industry remains in the dark as to the exact nature, limitations, and potential of these exciting new machines. A new series, starting on page 109, will endeavor to match this tool with the jobs it can do best.

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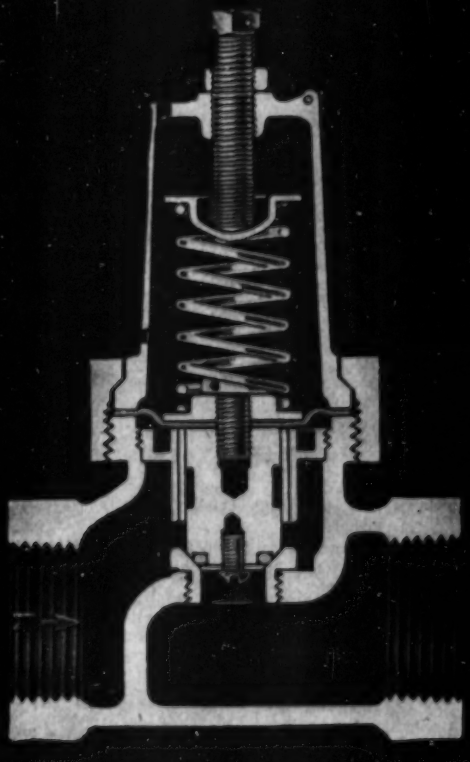
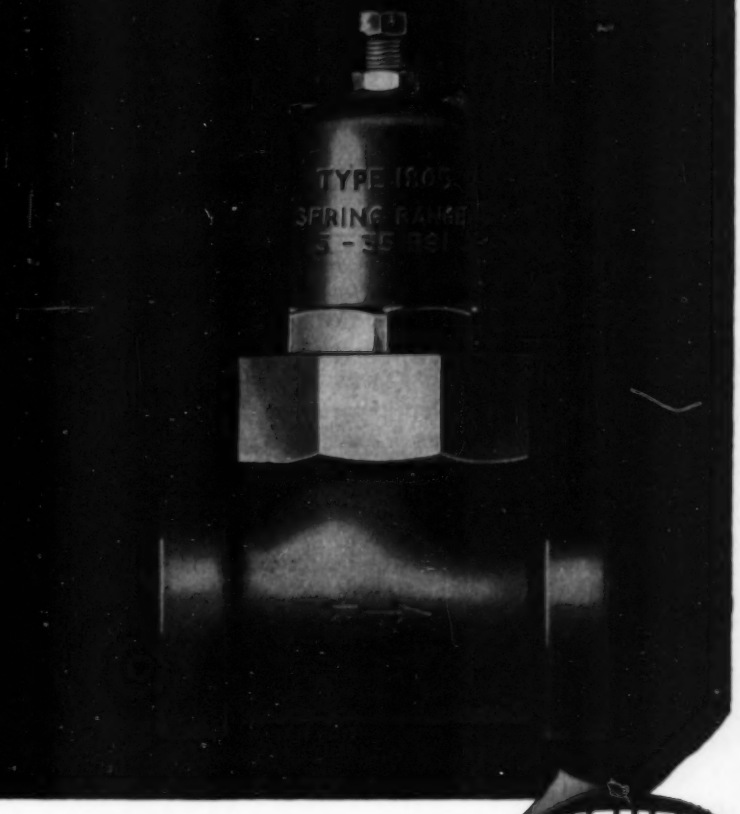
...On Commercials and Small Industrials

...On Schools, Hospitals and Public Buildings

...On Small Distribution Loops





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Our 75th ANNIVERSARY

BETTER GAS PRESSURE CONTROL

GAS Thermally Thinking

A bow to progress

IF THINGS don't look quite the same in your copy of *GAS* this month, rest assured—it's not the result of too much holiday celebration in the printer's composing room. It was designed that way.

Growth brings change, whether you like it or not. Personally, we like it. With *GAS* averaging 156 pages per issue in 1954, the old "saddle stitch" format, with its makeup limitations, was beginning to pinch. A page that should go there had to go here because another page, which should have been some place else, wasn't. Quite technical, really. It was becoming so complex that we even thought once of consulting a digital computer to solve this worry, but after learning from Managing Editor Ebdon's monumental work on this subject that the device is only as smart as the man who "programs" the problem (see page 109), we discarded it as a highly impractical idea. After considerable cogitating, without success, we finally hit upon the idea of "side-stitching" the book. Gives more flexibility, we learned. You can even print large gobs of unrelated pages in groups and then cut them apart and put them together in their proper places. But we trust the finished job doesn't look as if that had happened.

Once started, we couldn't stop. Next thing we knew we had a brand new cover cut. We wanted to "open up" the contents page and before we knew it the artist had slipped this page into the book. We restyled the department headings, too. But best of all, we've some sparkling new features. We drafted some top legal talent to prepare the "Legislative & Regulatory Trends," pages 11-12, an almost-every-month feature.

We cajoled Fred Hough into giving *GAS* readers an exclusive treatment on the background of the new gas section of the pressure piping code, which will without a doubt have the greatest impact on gas company operations of any single development in 1954, including the Phillips decision. The effects of the latter event must be (and will) be at least partially erased in the foreseeable future. But gasmen will live with their new code for a long time to come. They're lucky they wrote it themselves.

Speaking of the Phillips case, Order 174-A, *et al* (as who isn't these days), January should see some interesting developments. On the 11th, FPC will give producers the long-awaited opportunity to tell the commission how *they* think they should be regulated (if at all). It's too bad utilities won't be lending a helping hand, for it's their fight, too. Despite our remarks in the November issue pointing up the failure of many producers to join the forces of a truly integrated industry (we still feel they are valid) distributors have too much at stake to take a dog-in-the-manger attitude. If the days of cheap gas aren't coming to an end, they should be.

Obviously, the promised new "Kerr" bill won't be receiving active support from the distributors; there's too little time, for one thing. Breaking through the political habits of two decades is a long-term, continuing job. Persuading voters to begin asking themselves, "Why regulate?", not "Why not regulate" involves such fundamental changes in philosophies that nothing short of complete, total integrated industry effort can ever hope to even begin to accomplish it. The industry should speak, loud and often, at home and in Washington.

That gas has become a political football is an established if regrettable fact, but no amount of regretting will win this game. As long as the opposition has chosen to play it, we'd best get off the bench.

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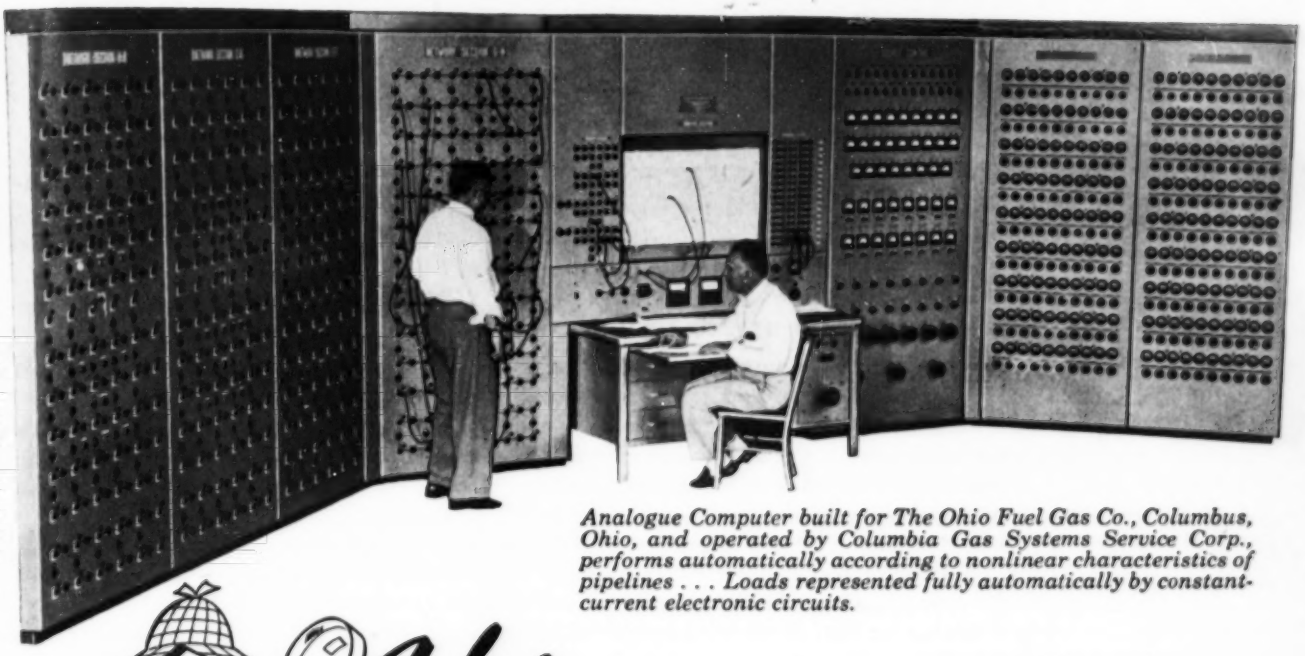

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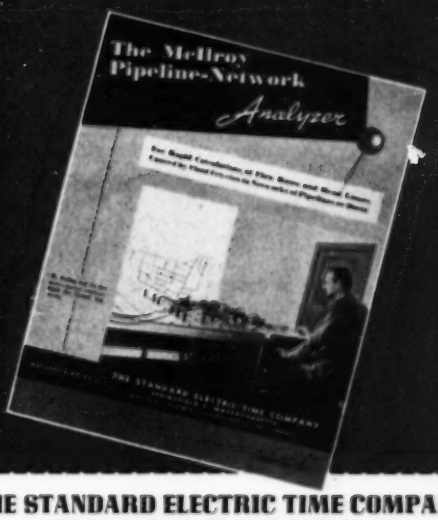

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highlights

GAS SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Headaches pile up for producers, courts, and the FPC

Confusion, becoming chaos is the situation in the newly regulated gas producing industry. Mass meetings, court tests, rate case disputes, and a drawing of battle lines were in the news in December. The general prediction that there would be 4000 appeals to the courts filed did not materialize, but at least five have been docketed. Temporary stays of Order 174-A had been granted in November to Magnolia and Ohio Oil, but FPC Counsel Willard Gatchell ruled the effects of these rulings would be limited to the companies involved. Just one day before the Dec. 1 deadline for rate filings set by FPC, Union Producing won a temporary injunction. The U. S. attorney general asked for dismissal of a suit filed by Stanolind against the government on the basis that it was "not a proper suit for the U. S. Government as a defendant." FPC has set a hearing for Jan. 10 on the proposal of Skelly Oil to cancel a gas delivery contract with Lone Star Gas.

The case of the reluctant exporter

Deep South Oil Co., a smallish east Texas independent, appeared to have gotten itself into deep water. Deep South had asked FPC for a declaratory order to determine its status under the Natural Gas Act. The company had found itself selling gas interstate against its will. In hearings, recessed now until Jan. 10, it developed that Deep South had contracted with McCarthy Chemical to sell its gas for intrastate use, but Texas Gas later took over the contract. Eventually the gas was commingled with other gas, which *was* moving across state lines. Is Deep South now in the soup?

Mayors stayed out of the fight

Even the American Municipal Association generated some heat over the Phillips decision at its annual convention in Philadelphia. The mayor of Kerrville, Texas, tried without success to put AMA on record opposing the decision. Milwaukee's Mayor Zeidler, who has become famous through the Phillips court battles, wanted the association to endorse the decision. But the chairman of the resolutions committee turned a deaf ear to both. The National Grange, on the other hand, publicly called for an amendment to the Natural Gas Act.

Doty stumps for amendment

Understandably, Gov. Allen Shivers of Texas sounded the call at the Interstate Oil Compact Commission meeting for Congressional action. So did Dale Doty, former FPC commissioner.

The news is out—Westcoast is on the team

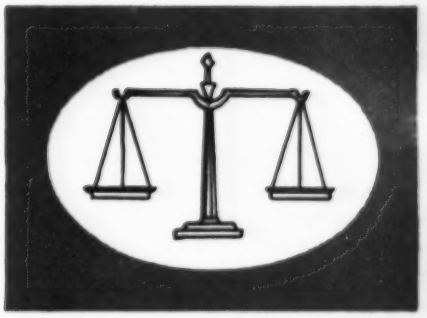
Long-lived rumors of a pact between Pacific Northwest and Westcoast whereby Canadian gas will feed into the Northwest have proved to have been well founded. And as was not completely unexpected, Paul Kayser, of El Paso Natural, biggest man in western gas supply circles, provided the key piece in the puzzle. In effect, most of the gas coming from San Juan will wind up in northern California, which was where he wanted it to go in the first place. (PG&E denies it is a "party" to the negotiations, but obviously it must eventually be if the proposed El Paso line is to be actually built.) Westcoast gas will serve most of the Northwest, which was what that company wanted in the first place. Ray Fish has his line and his financing and FPC will no doubt look much more favorably on imports that *could* be cut off without completely starving the area. Charles Gueffroy of Portland is satisfied. Two pipe manufacturers are overjoyed. All in all, the pact was a merry Christmas present to everyone concerned.

There was no recession in the gas business

Nineteen fifty-four lived up to all predictions in the gas industry. More customers, more sales, more revenue, greater saturation of househeating. Demand never did slacken, although appliance sales were off to a bad start. Evidences are piling up that utilities really mean to push this phase of their business in the years ahead.

*regulatory and legislative trends

Good news for '55: Allowed rate of return is rising



THERE is a significant increase in the national trend in rates of return allowed to natural gas distribution companies by regulatory commissions. In 33 decisions since November 1952, state commissions have allowed returns that average 6.8% on comparable rate bases. Recently the Federal Power Commission also has authorized higher rates of return than formerly for long distance natural gas pipeline companies, the highest being 6.25% on a depreciated original cost rate base.

The importance of the rate of return element in utility rate making is well known. Commissions traditionally have multiplied a property rate base by a selected percentage return to provide earnings to meet the financial requirements of outstanding bonds and stocks of the utility under review. An adequate rate of return accomplishes two objectives. It will keep a utility financially strong, which enables it to provide prompt, adequate and dependable service, which benefits all of the customers. An adequate return also will attract the necessary new money, on favorable terms, because it maintains investor confidence in the earning capacity and prospects of the utility. A utility is in competition for the investor's money with other utilities and non-regulated industries which possess comparable risks. Investors must be induced to commit their money to your enterprise and cannot be compelled to invest, because capital is careful, informed, and possesses freedom of choice in the multiple opportunities for investment. A relatively small change in the rate of return element is equivalent to a large change in the rate base, so the currently climbing trend in allowed rates of return should be encouraging to management.

The compensation which the United States Constitution guarantees an opportunity to earn must be sufficient to reimburse the utility for all operating expenses, depreciation and taxes plus a fair return. Capital charges on the debt, usually in the form of bonds, and dividends on stock with some earnings for surplus are just as much a cost of rendering service as are incurred operating expenses, depreciation and taxes. A reasonable rate to be prescribed by a regulatory commission may allow an efficiently managed utility much more, but a rate is constitutionally compensatory if it allows the utility the opportunity to earn the cost of service just defined.

In analyzing the trend in utility returns a distinction must be kept in mind between court decisions, which determine whether the regulatory commission's allowed rate of return results in confiscation, and the returns authorized by the regulatory agencies as being just and reasonable. A commission in its discretion may determine to be reasonable a return that is substantially higher than one sufficient to justify a judicial finding in a confiscation case. The mere fact that a rate of return is non-confiscatory does not indicate that it must be considered reasonable. It is well known that rates substantially higher than the line between validity and unconstitutionality may be deemed reasonable and not excessive.

Variation in the over-all dollar return to harmonize with changing economic cycles is one objective of utility rate-making. This can be accomplished by varying the rate base or the percentage return by which that rate base is multiplied, so that the resulting over-all dollar return will match the company's financial requirements.

The trend in commission-allowed rates of return is a barometer of regulatory climate, but to make a valid comparison on rates of return allowed on various types of rate bases, such as present fair value or original cost rate bases in the United States, one must convert them to a common base. For the 33 state decisions which were analyzed the rates of return were all converted to relate to an average depreciated original cost rate base for comparison. The range of allowed rates of return, on this comparable basis, was from a high of 9.44% in Pennsylvania to a low of 5.85% in California. Capital structure has an important influence on the composite cost of bond and stock money. Most of the regulatory commissions use the composite cost of capital as a guide to the measure of a fair rate of return. For the test group of natural gas distribution utilities the average capital ratios were 48% debt, 8% preferred stock and 44% common stock equity.

When using other utilities as a measure, it is assumed that they are earning a fair return and with the current high prices for cost of purchased natural gas, materials and labor that is a conservative assumption. In addition, this study of the allowed rates of return complies with the standard announced by the United States Supreme Court as long ago as 1923. In that *Bluefield Waterworks Case* the Court declared that a public utility is entitled to such rates as will permit it to earn a return on the rate base which it has devoted to the convenience of the public equal to that being made on investments and other undertakings which are attended

***Contributed comment on current developments by an expert in the field, to be a frequent feature in GAS for 1955.**

by corresponding risks and uncertainties. This comparability test has sometimes been interpreted to mean an examination of only the physical elements of comparability of various test groups of companies in rate fixing cases. This is an unreasonably restricted view. It would be just as difficult to find two utilities that are precisely alike physically as it would be to find two completely identical persons. This does not affect the practical fact that it is feasible to use a group of generally similar companies in the same field of business to make investment comparisons just as companies use current wage rates paid to an engineer as the basis for fixing the salary of a new engineer. To compete successfully for capital a utility must pay commensurate wages for the use of invested capital just as it pays comparable wages for labor.

The basic investment characteristics of a test group of natural gas distribution companies does not lose its over-all validity by reason of the fact that one company may have 80% residential consumers and another 60%, or that one is a $100 million company and the other a $50 million company. Comparative earnings information is a fundamental standard in the determination of rate of return because it is the only workable standard available. If we reject such comparisons we reject the law, which is an outgrowth of common sense and economics, and leave a regulatory commission with no guide by which it may exercise its enlightened judgment. When the Supreme Court wrote about comparative risks it manifestly was referring to comparable investment risks and did not restrict its criterion to any limitation of any specific physical characteristics.

Of course, a fair return is the result of using valid guides plus the exercise of judgment by the regulatory agency. From court and commission decisions certain judicially recognized principles surrounding the problem of return can be derived. Among these are the following:

1. A proper rate of return (percentage), or return (compensation) is a flexible concept and not a static rule.
2. What return is proper requires the exercise of enlightened judgment in each case.
3. Current conditions are controlling, and general conditions affecting all business should be considered.
4. The return should be sufficient to assure confidence in the financial soundness of the utility, to maintain its credit and to attract the necessary capital on reasonable terms.
5. The propriety of the allowed return depends largely upon the circumstances and risks.
6. The return should be equal to that realized concurrently on investments in other enterprises which have comparable risks.
7. The historical cost of money to the utility, and the current cost should be considered.
8. A utility's corporate structure, financial history and past operations should be considered.
9. The return should accomplish due recognition of efficiency or lack of efficiency in management.
10. The future prospects of the utility, its taxes and development and the character of the service should be considered.

By observing the rates of return authorized by commissions and the current higher trend, management can take hope for the future that more satisfactory rates of return will be granted to the $14 billion natural gas industry.

GAS selected bibliographies

4. Plastic pipe in the gas industry

This is the fourth in a series of selected listings of articles that have appeared in GAS over the past 30 years, covering a broad variety of subjects of particular interest to the gas engineer.

1943

Plastics (Post-War Notes and Notions), Stanley Jenks, *Oct., p. 32.*

1946

Plastic Tubing for Gas Service Piping, S. A. Bradfield and T. H. Gilbert.

Part I. Preliminary Investigation and Installation Standards, *Oct., p. 40.*

Part II. Laboratory Tests, Development, *Oct., p. 44.*

A New Material (Technical Trends), Guy Corfield, *Nov., p. 72.*

1948

Plastics (Technical Trends). Guy Corfield, *Aug., p. 21.*

1950

Plastic Pipe Again (Technical Trends), Guy Corfield, *Oct., p. 31.*

1951

Plastic for Distribution (Technical Trends), Guy Corfield, *April, p. 29.*

1952

Seven Years Experience With Plastic Services, Gordon G. Dye, *April, p. 45.*

Plastic Tubing Is Making Strides, *April, p. 49.*

How Plastic Tubing Is Inserted in Old Steel Services, *May, p. 55.*

What Next in Plastic Pipe (Technical Trends), Guy Corfield, *July, p. 29.*

Plastic Tubing Use Found Practical at Public Service Co. of Colorado, John F. Fugazzi, *Oct., p. 49.*

U. S. Plywood Develops New Glass-Fiber Pipe, *Nov., p. 58.*

1953

Important Slip of Paper (Thermally Thinking), *June, p. 26.*

Nation's First Plastic Mains Laid at Catalina Island, *July, p. 32.*

Progress in Plastics (Thermally Thinking), *Dec., p. 76.*

1954

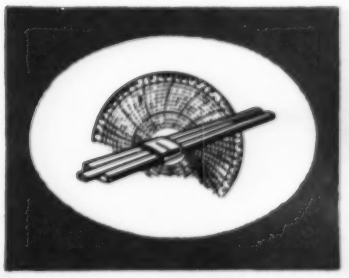
Interest Quickens in Plastic as a Prime Piping Material, William W. Clark, *Jan., p. 42.*

An Operating Man Looks at Plastic Tubing for Gas Mains, C. H. Weber, *Feb., p. 44.*

Plastic Pipe Specifications (Technical Trends), Guy Corfield, *March, p. 33.*

Plastic Internal Lines For Steel Pipe (Technical Trends), Guy Corfield, *Sept., p. 35.*

technical trends



• By GUY CORFIELD

Air infiltration measurements

In the study of space heating and ventilating, the build-up or dispersion of gases in rooms, and similar problems, it is convenient to have a means of measurement of air movement in and out of the areas under investigation. A space not hermetically sealed—and particularly when exposed to thermal gradients and wind pressures—will ventilate itself by air change at rates often equivalent to several times per hour.

The National Bureau of Standards has developed an instrument to measure air change in a space, based on the variation in concentration of a tracer gas introduced and dispersed in the area at the commencement of measurement. The basis of this development is that the number of air changes occurring during a given time is equal to the natural logarithm of the ratio of the tracer gas concentration at the beginning and at the end of the time interval; therefore, only the percentage change in concentration need be measured, and this can be determined readily by noting the change in thermal conductivity of the tracer gas-air mixture as the test progresses.

Helium is particularly suitable as a tracer gas because its thermal conductivity is about six times that of air. The bureau's meter, a thermal conductivity bridge, consists of two matched and equally heated thermistors connected to form two legs of a Wheatstone bridge, one thermistor sealed in pure air and the other exposed to the atmosphere of the space being tested. Unbalance of the bridge varies linearly with change in helium concentration and can be read directly on a microammeter. At the commencement of the test approximately one-half of 1% helium is added to the air in the room or area, and then measurements made as frequently as desired. Readings can be made successively at a number of points by installing probes at different locations, all connected to a central colsole. Details of this instrument can be obtained from the Technical Reports Section, National Bureau of Standards, Washington 25. D. C.

Recording and controlling rate of heat flow

The Bristol Co. has announced the development of a Dynamaster Btu recorder-controller system which can be used to continuously measure, record and control the quantity of heat supplied to or drawn from process vessels, refrigerating plants, air conditioners, and other heat exchanging devices.

The Dynamaster measures the temperature difference across the system, such as in piping to and from a thermal process, by means of two resistance thermometer bulbs inserted in the entering and exit piping, and also receives the rate of flow from a flow transmitter actuated by differential pressure across an orifice plate in the same piping; from these two variables, it continuously computes and records the Btu product. Other modifications are available that will furnish a two-pen record of temperature difference and Btu on the same chart, or Btu on one chart and either flow rate or temperature difference on another chart. Also totalizers can be furnished to integrate the measured quantities.

Technical report writing

The inability of many engineering college students and graduates to write a satisfactory technical report is causing concern in industry and educational circles alike. This is evidenced by the number of articles on the subject appearing in trade and technical journals and industry publications, and the efforts made by some educational institutions to include the use of the English language in their technical courses. It cannot be too strongly emphasized that the technical college graduate, whether he finds himself in research, operation or staff work, must depend largely on his reports for expression, evidence of his performance, and opportunity to create a favorable impression on his employers; he will be seriously handicapped if he is unable or unwilling to write a report that is reasonably well organized, complete without being verbose, and properly paragraphed and punctuated.

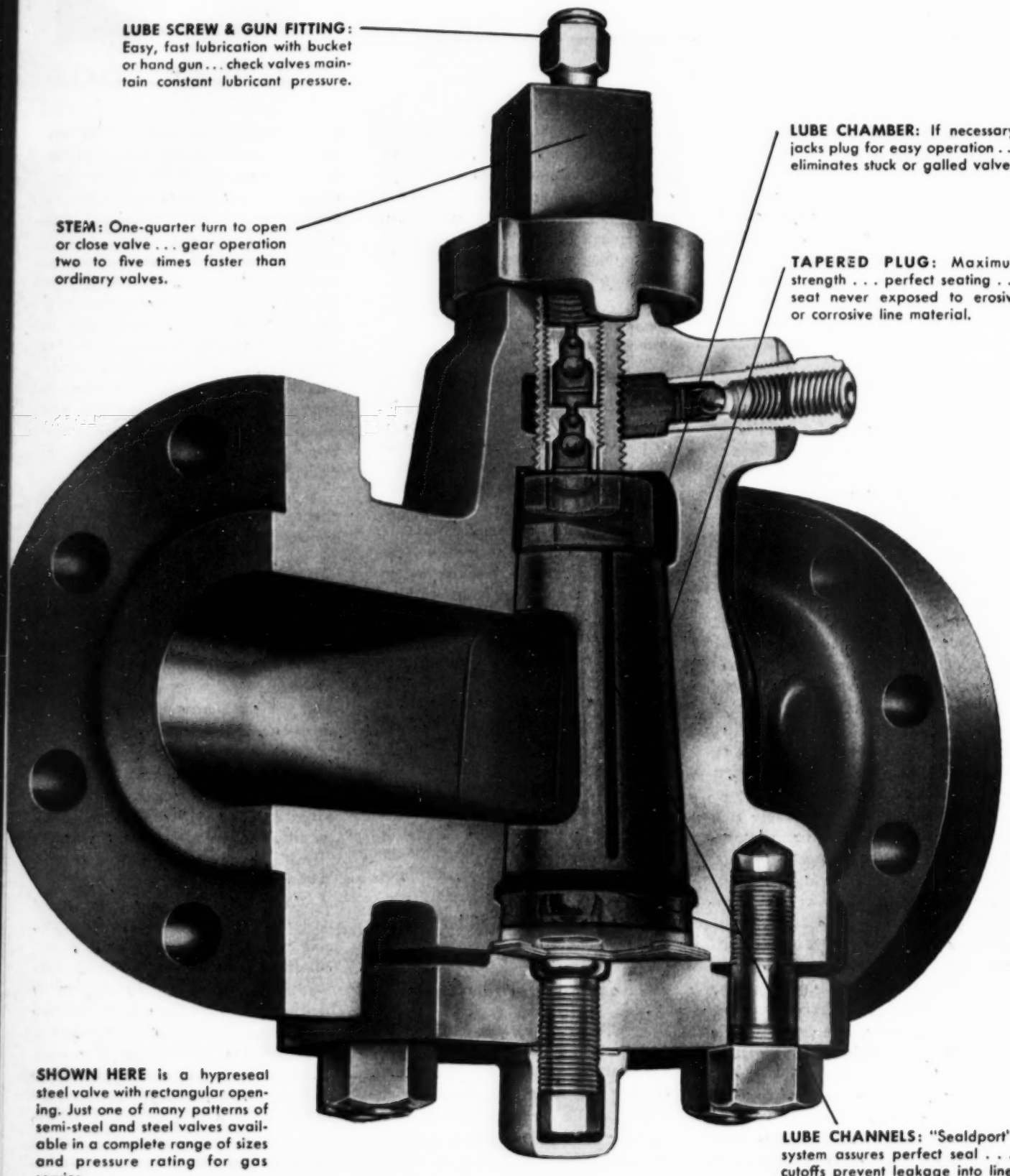
A recent article on this subject advanced the thought that some technical people are incapable of writing a satisfactory report, but are able to do valuable work if someone else can record and interpret it and therefore (consistent with this age of specialization) the employer in a large organization might feel justified in hiring report-writing specialists or ghost writers to help out the inarticulate technologist. It was stated that there might be some problem of signature and credit, to preserve the identity of both parties for future reference—perhaps this could be solved by copying the magazine article narrative style and signing the report "By Mr. Technologist as told to Mr. Writer."

While this professional or ghost writer expedient might be workable and even necessary under special circumstances, its possibility certainly does not provide an excuse for neglect of writing ability on the part of the ambitious technical graduate. One way to approach a technical report is to visualize the person to whom it is being written, decide how much he will want to be told, and then write as if telling him verbally with limited time and no opportunity for retraction or repetition.

Here's Why
Rockwell-Nordstrom Valves

LUBE SCREW & GUN FITTING: Easy, fast lubrication with bucket or hand gun... check valves maintain constant lubricant pressure.

STEM: One-quarter turn to open or close valve . . . gear operation two to five times faster than ordinary valves.

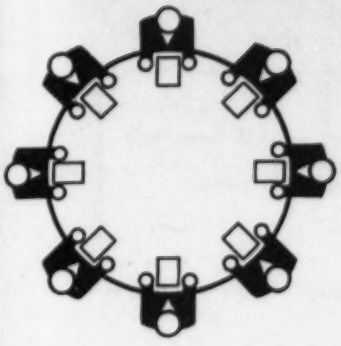


LUBE CHAMBER: If necessary, jacks plug for easy operation . . . eliminates stuck or galled valves.

TAPERED PLUG: Maximum strength . . . perfect seating . . . seat never exposed to erosive or corrosive line material.

SHOWN HERE is a hypreseal steel valve with rectangular opening. Just one of many patterns of semi-steel and steel valves available in a complete range of sizes and pressure rating for gas service.

LUBE CHANNELS: "Sealdport" system assures perfect seal . . . cutoffs prevent leakage into line . . . lubricant eliminates metal-to-metal friction.



The Management Issue

Year-end is traditionally a time for stock-taking. Not only sales results and forecasts, but overall management policies may be brought up for study. Many factors must be taken into account. For example, to note just a few . . .

What's the condition of the market? AGA and GAMA have released their latest reports (pages 42-45), which substantiate earlier predictions that 1954 would be a good year in the gas industry. The annual Phillips report shows a similar upward trend in the LPG business (page 57).

What will happen to the price of gas? That's anybody's guess, but William B. Tippy's guess is a highly educated one (see pages 46-50).

What constitutes a reasonable expenditure for gas main extensions? Here's a problem that has been answered in many ways by many different utilities (see pages 51-55).

What's the preferred basis for meter change-outs—age or mileage? This argument is far from settled (see pages 68-72).

What's the meaning of the gas section of the new code for pressure piping? Some clues may be found in examining the background of the code, as Fred Hough does on pages 58-59.

Househeating is a peak-load mixed blessing; how can the valleys and fringe dips be filled in? Brooklyn Union has found some answers to that one (pages 60-67).

Are digital computers economic for use in gas operations? (See page 109).

GAS

JANUARY 1955

$14 billion industry has its biggest year

Twenty-eight million customers, consuming nearly 61 billion therms, brought revenues of $3 billion to the nation's gas utilities — all new records for the sixth largest industry in the United States.

STRAINS of the long familiar year-end theme are being wafted over utility rooftops as we roll into 1955. Though we know them by heart, the lyrics are nonetheless music to our ears. They go something like this:

"Last year was the greatest ever, and next year will be even better."

Though the rime is not there and the meter is faulty, the line carries real significance for the nation's sixth largest industry. In virtually every phase of its operations, 1954 was the greatest, and 1955 appears to be more of the same. Until the day when househeating waiting lines evaporate or gas prices itself out of the market, or people quit raising families—or a combination of all these unforeseen events comes about—the theme is likely to hold.

In 1954 we had more customers, more miles of line, sent out more gas, had larger revenues, banked more gas in underground storage, and located more reserves than ever before. If our range sales could not quite keep pace, strong efforts in promoting automatic hot water heaters and gas househeating set these two phases of business on the right track after a shaky start. And we plunged into the Gas Industry Development program with a will and determination that was most promising of better appliance selling days to come. We were, in effect, carving out some new (to the gas industry) wilderness.

Consider these statistics, selected from the annual report of F. M. Banks, president of the American Gas Association:

Gross assets of the industry, $14 billion.

Annual capital expenditures, 1954, $1 billion. (This level is expected to be maintained through 1957, to give a four-year total of expenditures aggregating $4 billion.)

Total number of customers: 28 million, including 22 million on natural gas and 5.8 million on manufactured and mixed gases. (The annual growth is running around 800,000, or about 2.8%, and by the end of 1955, Mr. Banks estimates the industry will be serving 29 million. Manufactured and mixed gas customers continue to shrink in numbers, but natural gas, which replaces the other fuels on a regular basis, much more than makes up for this loss.)

Total sales of utility gas in 1954: 60,750 million therms, up 7.6% over 1953's all-time record. (Of this, natural gas sales accounted for 57,440 million, up 8%. Even manufactured and mixed gas sales were up slightly—.09%—despite the drop in customers.)

Revenues, in 1954, a record $3 billion, up 10.8% over the previous record high of $2.7 billion, established in 1950. (Natural gas revenues were up 13% to a new record, $2544 million. Manufactured and mixed gas revenues reached $448 million, up .1%.)

Total miles of pipe, 463,000. (That would circle the equator 18 times, and it's the greatest mainline transportation system in the U. S. More than 17,500 miles of natural gas lines were laid in 1954.)

To lay all those lines, sell all that gas, and reap all those revenues, the gas industry had to do some heavy appliance selling; and in 1955 it confidently expects to do even more. T. T. Arden, president of GAMA, says flatly:

"If the combined gas appliance industry doesn't do 10% more business in 1955 than in 1954, it won't be for lack of opportunity."

Ten percent more than what?

Sales of central heating appliances, for one thing. In 1954, sales in this category totaled an estimated 921,000 units, which represented a 15% increase over the 1953 figure of 800,000.

Or of automatic gas laundry units, which are beginning to catch on. In 1954, sales of dryers hit a new peak of 200,000, up 40,000 or 25% over 1953 sales.

Or of automatic gas water heaters, which in 1954 took over first place from ranges. Two and a quarter million units were sold, compared with a figure of 2,182,000 sold in 1953—a gain of more than 3%.

Or of gas ranges, which couldn't quite hold the 1953 pace, slipping from 2,-

"If the combined gas appliance industry doesn't do 10% more business in 1955 than in 1954, it won't be for lack of opportunity," declared GAMA President Arden.

183,000 in 1953 to 2,010,000 units in 1954, a loss of more than 3%.

Performance of all appliances was commendable in the light of general economic conditions. The showing of automatic water heaters was remarkable.

Interpreting all this in terms of the future requires a look at the various factors that will have an impact on the market this year.

First off, there's demand; and Mr. Arden cites the experts' opinions that this year will see new all-time records in home construction.

"Besides the possibility that more than 1.3 million new homes will be built, there is a great opportunity for us in the fact that Americans will spend better than $6,250,000,000 on rebuilding old dwellings, adding living space, modernizing kitchens, laundries and basements, and generally providing the setting for a huge replacement market for appliances," Mr. Arden reports.

Furthermore, GAMA believes that by the end of 1955 there will be at least three major uses of gas in the average home where only one existed in 1945!

Distributors and dealers are optimistic about demand, too, as is evidenced by the manner in which they ordered heavily in late 1954 to bolster inventories depleted by the mid-summer shakeout and political scare-talk.

Where there isn't an overwhelming demand, the utilities are likely to bend every effort to create one. Mr. Arden points to the fact that gas utilities, less hampered now by worries about how they will get enough supplies of gas to satisfy their customers, are flocking back into the direct and indirect (through dealers) merchandising of the equipment that uses the gas they sell.

An outstanding example of this emphasis is GID. Quoting President Banks:

"During the year, 10 gas companies in strategic areas of the United States designated part of their service territory as Action Demonstration cities under the Gas Industry Development program, which was launched in 1953 to strengthen the competitive position of gas as a major domestic fuel. The designated cities were: Lincoln, Neb.; Lansing, Mich.; Abilene, Texas; Ocean City, N. J.; Fort Wayne, Ind.; Altoona, Pa.; Savannah, Ga.; Pasadena, Calif.; Albuquerque, N. M.; and Springfield, Mass.

"The companies serving these cities are undertaking their own experiments, providing sales, promotion, operating and servicing policies. Those experiments which prove successful in these territories presumably will be applied to the rest of the company operations. Also it is expected that other companies will be spurred to similar activities by results from these 10 Action Demonstration cities.

"The 10 companies already are reporting much better appliance sales results for themselves and for local dealers than would have been accomplished otherwise. All of the companies concerned are so impressed with the results that they are continuing the action programs next year and are using the successful activities throughout their entire systems."

Expenditures for new plant and equipment will continue at a high rate in the first quarter of 1955, although somewhat below the average for 1954, according to a survey made in November by the Department of Commerce and the Securities and Exchange Commission. Investment in early 1955 is planned at a seasonally adjusted annual rate of $26 million.

According to the survey, gas and electric utilities have scheduled some reduction early this year from their 1954 construction programs. Trends in durable-goods manufacturers expenditures show comparatively little change in the first three months of 1955.

Investment programs of public utilities show a 7% drop between the fourth and first quarters, after seasonal adjustment. The survey showed that expenditures by gas utilities fell off considerably through 1954 and projected outlays in 1955 are well below the 1954 average.

Statistical surveys show where all this burst of energy might lead. Given favorable, yet attainable, conditions, the industry can achieve these sales results in the next three or four years, as indicated in recently published AGA reports:

New househeating customers will be added at a rate of 1.2 million per year. By 1957, space heating requirements will be 53% higher than in 1953.

By 1957, overall gas sales by utilities will reach 75 billion therms, 25% higher than 1954's record of 60 billion.

A total of 59 million gas appliances of all types can be sold between 1954 and 1958.

AGA President Banks reports that the 10 companies participating in the Action Demonstration program are so enthusiastic that they plan to continue the program in 1955.

Gas-heated homes should total 15 million by the end of 1955, 17 million by the end of 1957. That's a saturation that would have seemed fantastic a few short years ago.

Industrial demand is expected to increase by 30% by 1957.

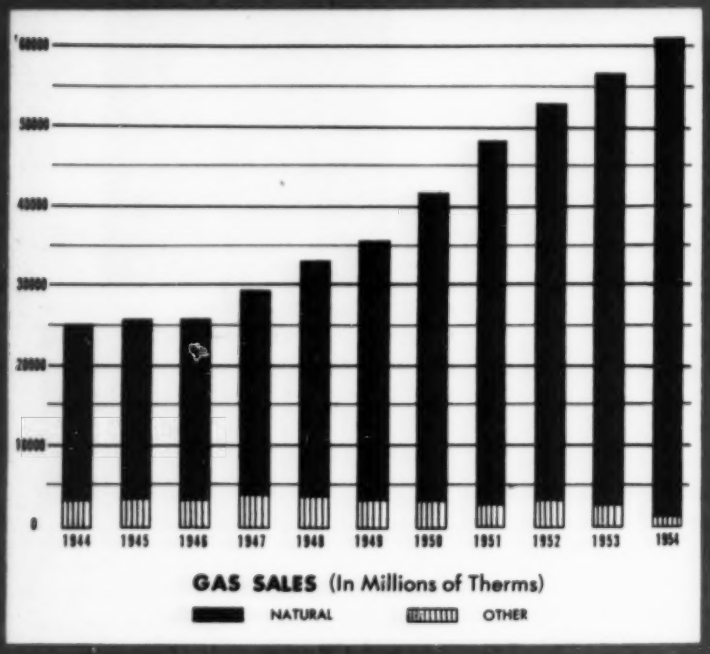
To back up this activity, there has to be gas; and unless the current wrangle between FPC and producers has more far-reaching results than most industry leaders would have us believe, available reserves will continue to climb. As reported last spring, proved recoverable reserves now stand at 211.4 trillion cu ft, 11.7 trillion higher than a year ago. And those who are in a position to know are betting that the ultimate findings will surpass 600 trillion cu ft, some 100 trillion more than Lyon Terry of Chase National Bank was willing to predict just three or four years ago.

Underground storage development goes on space, giving distributing companies the advantage of availability for peak load use. The industry spent $50 million in the past year adding to the 167 storage fields in 17 states, which at the start of the year held a total of 1735 billion cu ft.

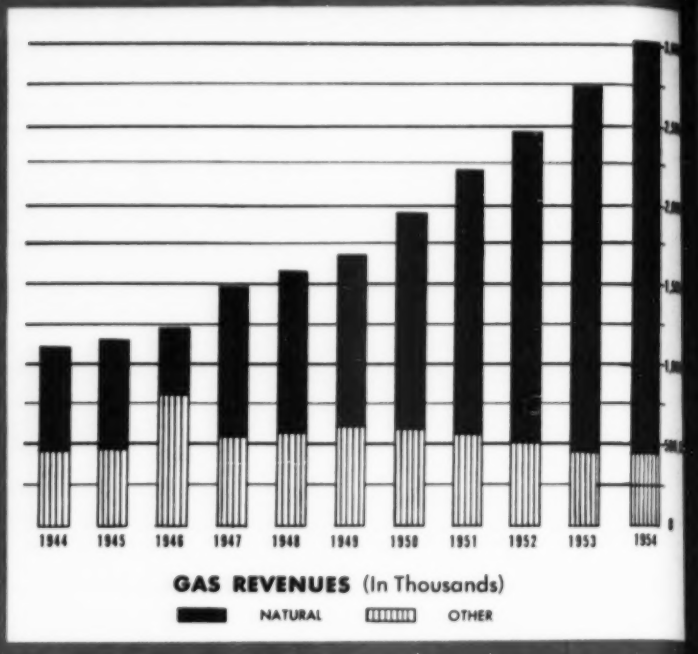
To get these supplies to market, the AGA statistical study showed that gas utilities from 1954 to 1957 would spend $4 billion. A portion of this will go for steel pipe, of which 4.6 million tons will be required in the four-year period. Half-a-million tons of cast iron pipe will be bought in the same period.

All in all, it's difficult to believe that we'll be changing our tune in another year, or two, or five. Things just seem bound to keep on getting better and better. ■

Inventory of the gas industry hits new peaks →



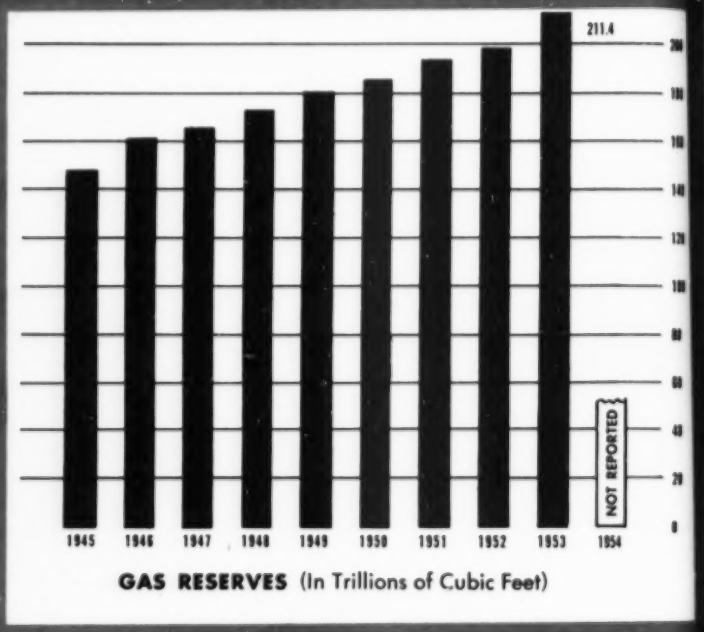
GAS SALES (In Millions of Therms)



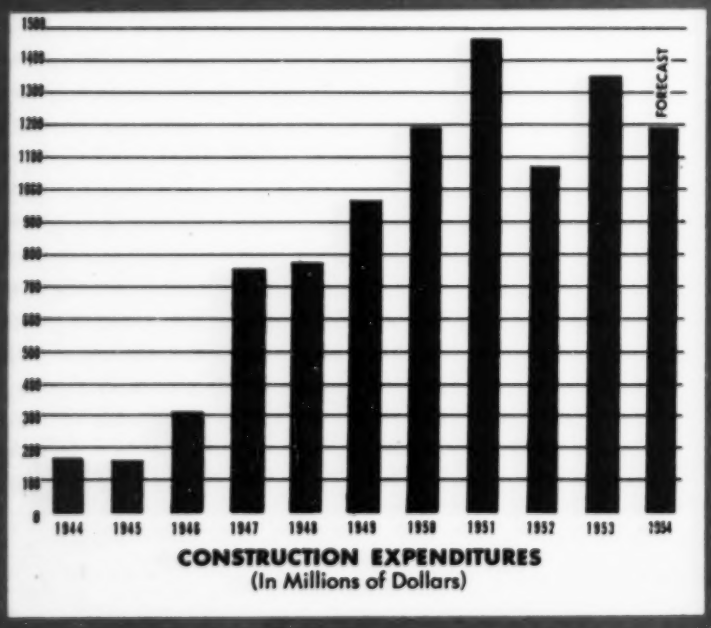
GAS REVENUES (In Thousands)

Inventory of the Gas Industry

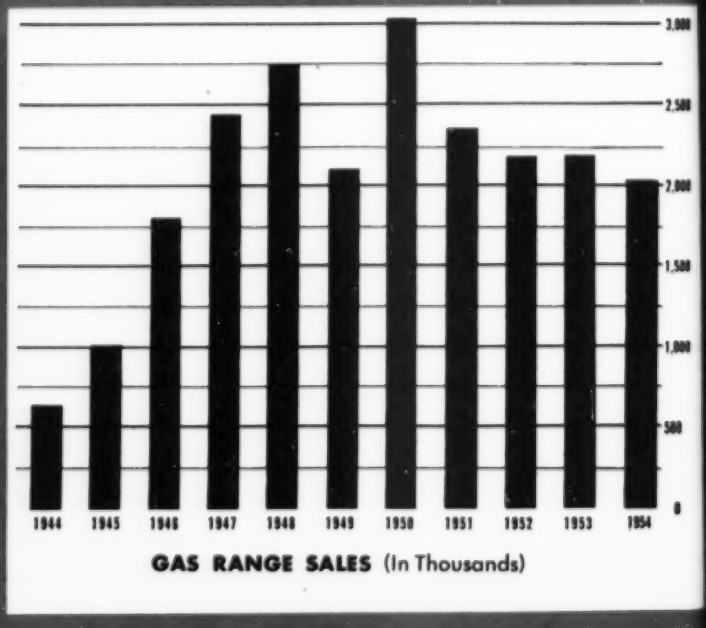
DECEMBER 31, 1954



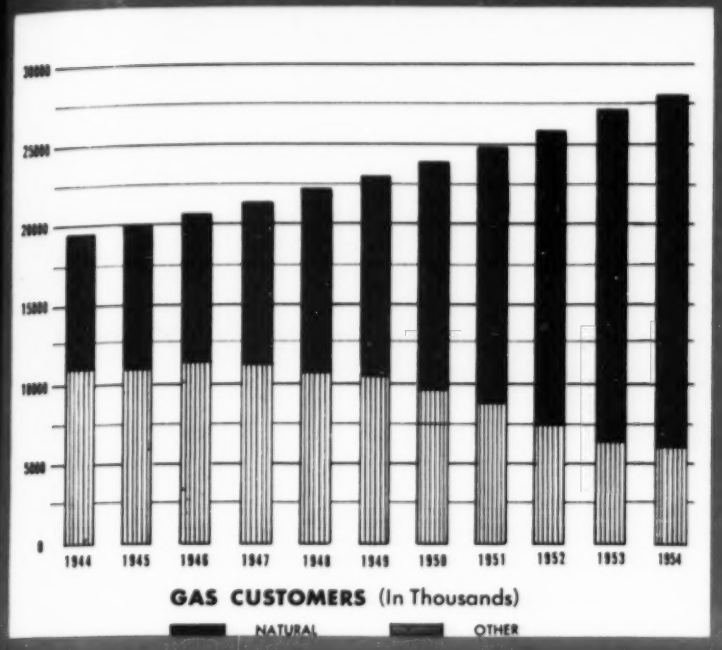
GAS RESERVES (In Trillions of Cubic Feet)



CONSTRUCTION EXPENDITURES
(In Millions of Dollars)

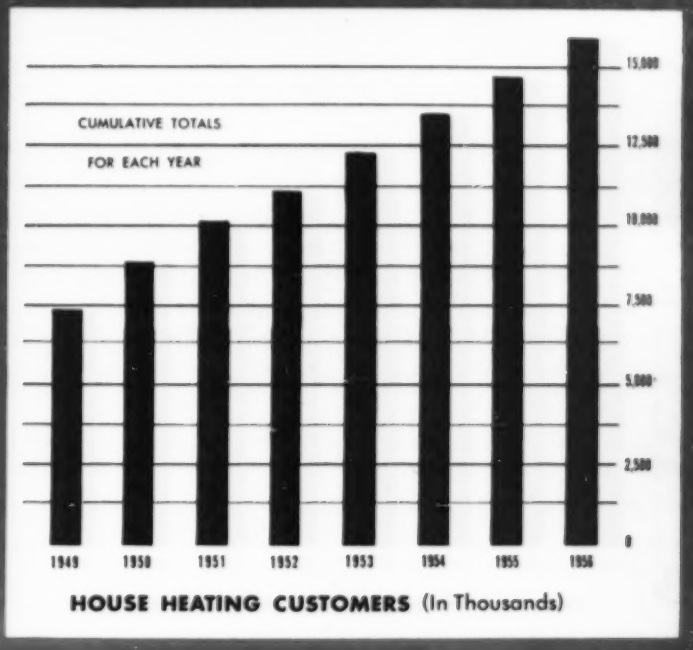


GAS RANGE SALES (In Thousands)

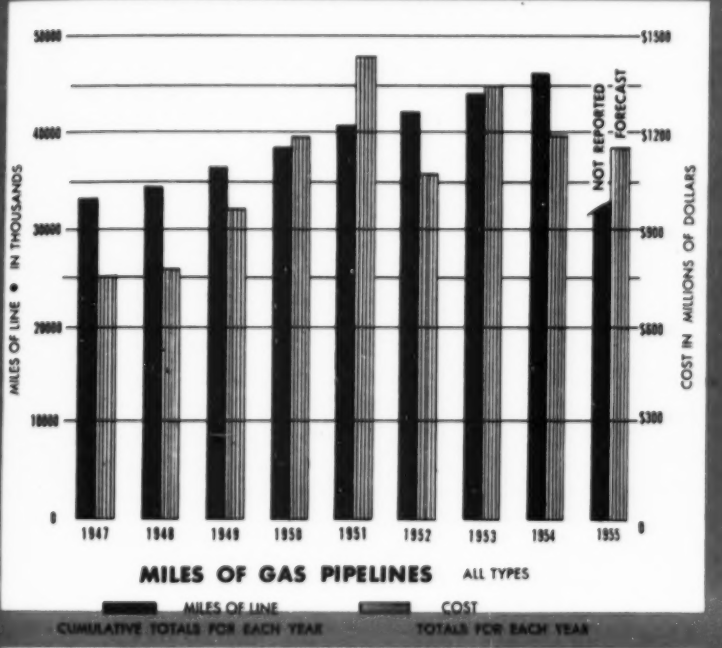


GAS CUSTOMERS (In Thousands)

NATURAL OTHER

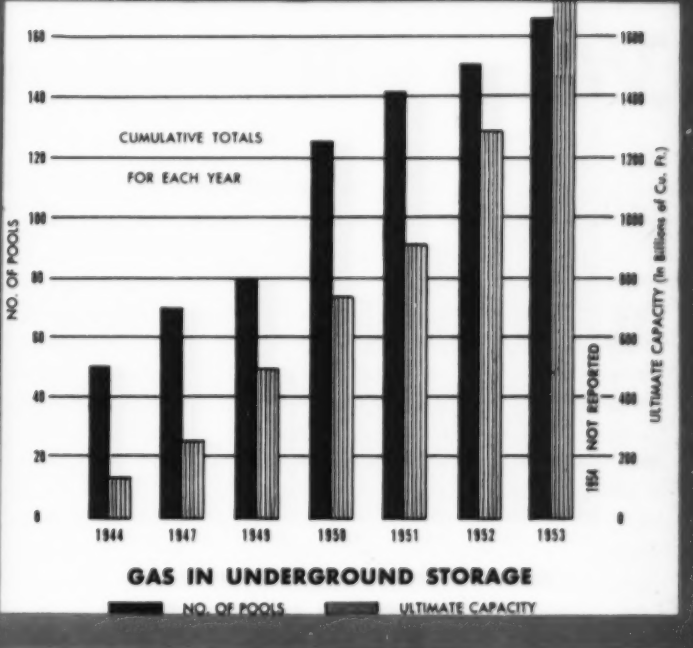


HOUSE HEATING CUSTOMERS (In Thousands)



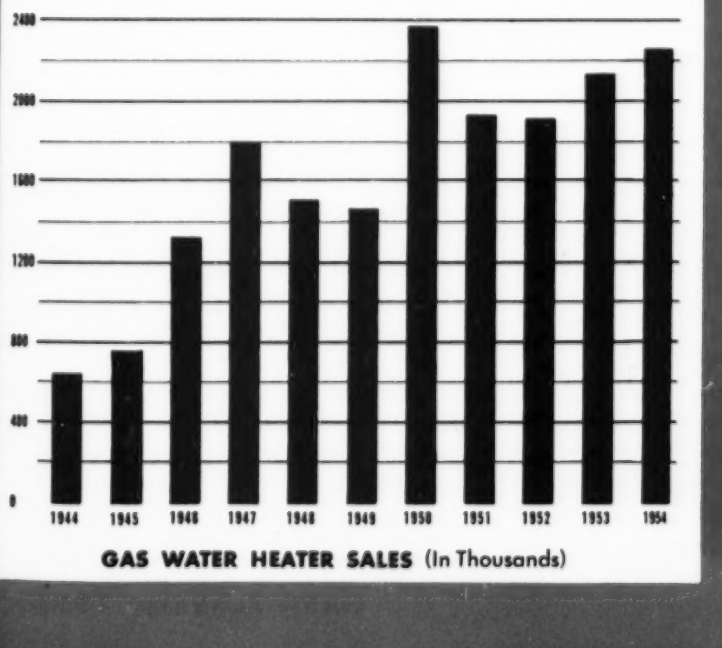
MILES OF GAS PIPELINES ALL TYPES

MILES OF LINE CUMULATIVE TOTALS FOR EACH YEAR COST TOTALS FOR EACH YEAR

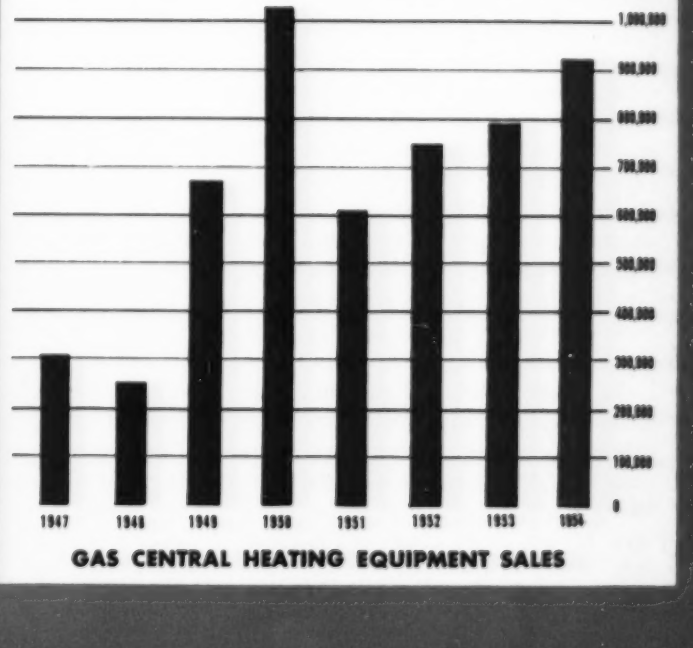


GAS IN UNDERGROUND STORAGE

NO. OF POOLS ULTIMATE CAPACITY



GAS WATER HEATER SALES (In Thousands)



GAS CENTRAL HEATING EQUIPMENT SALES

The historical elements of control on the price of gas—competition at the wellhead and regulation along the pipeline and at the distribution end, the latter also being affected within the limits of rate structures by a competitive factor—have been upset by the addition of a new element—regulation at the wellhead. This situation in turn is further modified by the trend within the FPC to recognize a fair field value of gas produced by transmission companies, a policy that seems to indicate the commission, while keeping a jealous hold on prices made at arm's length, will nevertheless tend toward leniency in setting those rates of independent producers.

So it's pertinent to ask, as we round another year's end, "What Will Happen to the Price of Gas?"

The author feels that, in the final analysis, competition holds the key to the answer.

What will happen to the price of gas?

By **WILLIAM B. TIPPY** • Commonwealth Services Inc., New York

WITH the marked rise in the field price of gas over the past few years, accompanied, as it has been, with an apparently never-ending chain of applications by the natural gas transmission companies to the Federal Power Commission for wholesale city-gate price increases, the question "What will happen to the price of gas?" has been uppermost in the minds of many—not only throughout the natural gas industry but among its consumers and security holders as well. For a clear answer to the question, a reliable crystal ball would undoubtedly prove most welcome. Since no such device is presently available, I suggest that *competition* in our still-reasonably free economy will provide the key to a logical answer. An analysis of the competitive situation in the several segments of the natural gas industry—production, transmission and distribution—should therefore provide us with at least an approach to the problem.

As to the short-term outlook, there never has been a period when more confusion existed. From many viewpoints, we are indeed in what the *Wall Street Journal* recently chose to call a "Gas Morass." The confusion is greatest at the production level but extends on to both the transmission and distribution phases of the industry. The competition of new or expanding pipelines for additional purchases of gas from the gas producers, together with the influence of local minimum field price regulation, which has come into being in two of the producing states within the last few years, have been pushing the field price of gas upward. Now two new significant factors, not yet fully evaluated by the industry, are contributing to the general confusion on gas field price trends. These factors are:

First, the Federal Power Commission's fair field price policy laid down in the Panhandle decision this spring, and

Second, the United States Supreme Court Phillips decision, which has placed gas producers under Federal Power Commission regulation, together with subsequent FPC action.

The Panhandle decision in April 1954 was a departure from the Federal Power Commission's prior policy, which fixed the price allowed for gas produced by a pipeline company on "cost of service" based on original cost of the company's production facilities. The Panhandle decision, instead, allowed Panhandle Eastern Pipe Line Co. to attribute to its own gas production a weighted average of the field prices of the gas purchased by the pipeline company from others in the same area. This marked change in policy, recognizing a measure of value in regulating pipeline gas production, was, as FPC Chairman Jerome K. Kuykendall stated in a talk before the American Petroleum Institute at Chicago, Nov. 9, 1954, "done with full knowledge of the pendency of the Phillips Petroleum case." The Panhandle decision thus assumes increasing importance in endeavoring to predict the future course of gas field prices. Value at last appears to have found its way into FPC natural gas regulation, at least to a limited extent.

The June 7, 1954 decision of the United States Supreme Court in the Phillips case, followed as it has been by the Federal Power Commission's Rule 174A, brought the producing phase of the natural gas industry face to face with federal regulation in an abrupt manner. The reaction of the producers was immediate and vocal, and has been continuing. The fears expressed to date relate principally to price uncertainty

under federal regulation where the regulatory process has apparently abrogated or definitely modified escalation and cancellation provisions of existing contracts and has set the stage for replacing contract prices with administrative determinations. This raises the question of whether long-term contracts arrived at by arm's-length bargaining will be fulfilled and focuses attention on the destructive effect on future exploration and, indeed, on future drilling to increase production from known reserves which would be expected to result should the FPC adopt a restrictive original cost type of regulation in regard to production.

It is the position of the producers, seconded by many throughout the industry, that production should not be regulated at the Federal level because of its very nature. They point out that in 1953 the sums expended on exploration and development of oil and gas production in this country amounted to $2 billion, which they state "closely approximates the amount of revenues received in 1953 from the sale of natural gas at consumer level." The ratio of successful wells to dry holes has declined in recent years, yet risk money for exploration and development must continue to be found and the search for gas and oil must be continued and new sources discovered to meet growing requirements if the natural gas industry is to stay healthy. The producers feel that this can be accomplished only by removing their segment of the natural gas industry from the area of Federal regulation.

The pattern of regulatory policy of the Federal Power Commission with regard to producers is not yet apparent. The filing requirements set forth in Rule 174A were relatively moderate when compared to those applying to transmission companies under FPC regulation. Nor do the actions of the commission to date with regard to producers' prices yield any definite clue as to a developing pattern of price regulation. There have been many more approvals of price increases than there have been disallowances, but the lack of any opinions and orders accompanying either approvals or disallowances obscures any possible pattern. Perhaps the best clue to date may be found in Chairman Kuykendall's address to the API last November, in which he stated that the commission recognizes that the characteristics of the gas producing industry are quite different from those of the gas transmission industry and that within the discretionary room left to the commission by the law, the commission is endeavoring to simplify its techniques to meet the wholly different problems which are now before it.*

He indicated that the commission's plans were in the formative stages and that it proposes to obtain the views of all the interested parties concerning the methods and standards that could be properly applied in regulating the price of natural gas sold by producers. Requests that suggestions be submitted by mid-December did go out from FPC. It may well be that the implementation of the policy statements of Chairman Kuykendall may produce a regulatory result that will minimize producers' fears, if they are not completely relieved by legislative changes or some other negation of the Supreme Court Phillips decision. A "fair value" regulatory policy, if adopted by the FPC for the regulation of producers' prices, might produce such a result.

The possibility of a change in the Natural Gas Act to exempt producers from FPC regulation is real but may prove difficult to attain in spite of the work now being done by many toward this end. Remembering the difficulties which accompanied the passage of the Kerr Bill through the Senate a few years ago and recognizing the price rises with which the consuming states have been faced since that time, it is obvious that the task will not prove easy. The best long-term prediction, therefore, seems to be that regulation of production at the Federal level in some form is likely to continue for some time but that the real effect of such regulation may be considerably different and less drastic than that presently envisioned by the producers.

*For further details on Chairman Kuykendall's comments, see "Kuykendall Cites 'Commission Discretion' as Ray of Hope for Gas Producers," by William W. Clark in *GAS*, December 1954, page 46.

Mr. Tippy is executive vice president of Commonwealth Services.

Regulation or no regulation, the price of natural gas, in my opinion, will ultimately come to rest at a balance point dictated by competition at the consumer level. The interposition of regulation into the picture can only have the effect of slowing up the rate at which price in the field approaches the competitive level and may perhaps cause the whole producing industry to approach the competitive point with more uniformity. Regulation could thus make the rise to the competitive ceiling somewhat more orderly, but in the long run it is competition itself that will set the ceiling.

Competition—not perfect but nevertheless active—is apparent in the following four areas pertaining to the natural gas industry:

1. Among pipelines for supply.
2. Between pipeline gas and alternative means of supply.
3. Between gas and other competing fuels at the point of utilization.
4. Between gas and other energy forms which may have future significance.

First, competition among pipelines for gas supply to support growth of existing lines or the establishment of new lines to new areas has been most apparent in the Mid-continent and Gulf producing areas since the end of World War II. The great expansion of demands for natural gas in the consuming areas to the north and east of the gas fields commenced only after oil and coal were released from regulation after the

"Regulation or no regulation, the price of natural gas, in my opinion, will ultimately come to rest at a balance point dictated by competition at the consumer level. The interposition of regulation into the picture can only have the effect of slowing up the rate at which price in the field approaches the competitive level and may perhaps cause the whole producing industry to approach the competitive point with more uniformity. Regulation could thus make the rise to the competitive ceiling somewhat more orderly, but in the long run it is competition itself that will set the ceiling."

war. Natural gas, a premium fuel for domestic househeating, then became the bargain fuel. The search by pipelines and proposed pipelines for reserves in the Mid-continent and Gulf areas accentuated the need to encourage producers to develop known reserves more fully and search for additional fields. This, in turn, bid the price up sharply on a somewhat irregular pattern. In certain areas in Oklahoma and Kansas, from which the bulk of the gas was exported to other states rather than consumed locally, a substantial portion of the royalty owners felt they were being overlooked by the parade of rising gas prices elsewhere. These royalty owners lost confidence in the ability of competition to set reasonable prices with the result that a theory of minimum field price regulation, in the name of "conservation," was developed. When considered along with the local self-interest aspect of this sort of price protection, minimum field price regulation in itself raises the question of whether there should not also be a countering maximum price protection on a broader national level if all segments of the public are to be properly protected.

Of course, the rising trend in field prices, whether by virtue of competition or by minimum field price regulation, reaches its limit when that field price, added to the cost of long distance transportation and distribution to the ultimate consumer, becomes more than the market can pay. A pipeline is a high investment facility of fixed maximum daily capacity, and its fixed charges, in the form of depreciation, taxes and return, go on day by day throughout the year. The requirements of the domestic and commercial customers demand the full capacity of the pipeline on the coldest days of the year, but, on the average, utilize less than half of the pipeline's capacity throughout the entire year. Today much of the remaining half of the pipeline's annual capacity is used to supply gas to large-volume interruptible industrial customers.

As long as these highly competitive sales can be made profitable, they help to carry the pipeline's fixed charges. When prices of gas rise or the prices of competing fuels fall, as in the instance of importation of low-priced oil from foreign sources along the seaboard, so that the interruptible sales can no longer be made, or cannot be made at a profit, all of the pipeline's fixed charges must fall back upon the gas sold for domestic and commercial use, with the resulting pyramiding of the price for domestic and commercial gas to a point where it, too, reaches or passes competitive limits. Of course, there are some offsets to the rise of gas, principally the gradual decline in such pipeline fixed costs as return and associated federal income taxes as the rate base for a given pipeline facility is reduced due to the amortization of cost under the FPC's original cost rate base theory; but gas price increases in the fields have well exceeded such offsets in recent years and, in addition, the effect of declining rate base has been somewhat obscured by recent expansions of most pipelines at today's higher construction costs.

Also, the development of underground storage of natural gas has the effect of making at least part of the summer gas available for domestic and commercial winter use and thus, for the pipelines that have such underground storage available to them, may help to raise the competitive limit for the price of gas in the field. It should not be overlooked, however, that the development and operation of underground storage facilities adds to the cost of the entire operation.

In the application of the foregoing general principles to specific producer-pipeline-distribution company situations lies the answer to the loose and quite misleading statements made recently by representatives of one element within the producers' group to the effect that gas in the field costs only a few cents—while the *average* distributor's retail price may be over a dollar or so. The inference is that the spread provides room within which the field cost of gas may rise without much effect on anyone. This line of reasoning completely overlooks two major facts basic to pipeline and distribution company economics:

First, that the entire spread between cost of gas purchased in the field and the retail sales price is made up of fixed charges (depreciation, return and taxes) and operating expenses necessary to finance and operate the facilities required for transmission and distribution and that the final retail prices are the result of strict return-on-investment-type regulation, except where competition will not permit a full return to the seller. There is no room for absorption of producers' price increases; they must be passed on to the consumer, in an increasing number of cases by cost-of-gas adjustment clauses.

Second, no gas is sold at the distributors' *average* retail price. Half the gas transported through a given pipeline is sold on an interruptible basis in large volumes for industrial uses at highly competitive prices, far below the distributor's average retail price. Of the remaining half, 50 to 75% is sold at low load factor for space heating purposes at prices set by regulation but limited by competition with oil. The remainder is sold for cooling, water heating, refrigeration—domestic and commercial—and as firm industrial uses. The retail prices for such gas will be above the retail "average," but are again set by regulation and limited, in this case, by electric competition. All these markets have definite limits as to both volume and price and the specific load factor patterns at which they must be served. Loss of interruptible sales cannot be made up by increased sales in other categories made from the same facilities in a given area. Similarly, loss of space heating sales cannot be offset by additional industrial sales, without the seller experiencing a substantial loss in revenue. Any change in a company's sales pattern which would upset its balance through loss of any segment of its sales volume, shifts fixed charges to the sales remaining and has the pyramid

"Any change in a company's sales pattern which would upset its balance through loss of any segment of its sales volume, shifts fixed charges to the sales remaining and has a pyramid effect. And, in many areas throughout the country today, a relatively small increase in the commodity cost of gas can price gas out of presently held large-volume low-price markets, touching off this price pyramid effect."

"The pattern of regulatory policy of the FPC with regard to producers is not yet apparent. The filing requirements set forth in Rule 174A were relatively moderate when compared to those applying to transmission companies under FPC regulation. Nor do the actions of the commission to date with regard to producers' prices yield any definite clue as to a developing pattern of price regulation."

effect previously described. And, in many areas throughout the country today, a relatively small increase in the commodity cost of gas can price gas out of presently held large-volume low-price markets, touching off this price pyramid effect.

General price inflation since World War II and the recent rapid rise in the field price of gas have gone far to close the competitive gap that developed for the natural gas industry right after the war and have materially sharpened the problem of meeting such further price and cost increases as may face the natural gas industry. The day of broad generalizations concerning natural gas competition is past and the impact on each individual situation must now be considered in detail before steps are taken by any element of the industry which would further increase the retail price of gas.

Secondly, competition between pipeline gas and alternative means of supply (e.g., gas manfactured from oil or coal by techniques now known or under development) may provide a very real and immediate ceiling to the price of pipeline natural gas and hence to the price of gas in the field. Until now, natural gas has had little competition from other fuels, but it is of immediate interest that techniques for the manufacture of high Btu oil gas, interchangeable with natural gas, already exist and must be taken into account by the pipeline companies in their rate planning. In New England, some of the distribution companies state they are making high Btu oil gas in existing equipment at production costs of the order of 55 cents to 60 cents per Mcf of natural gas equivalent. Figures published by the Portland, Ore., gas company indicate that its production costs for the year 1953 were 54.6 cents per Mcf of 1000 Btu natural gas equivalent. While these figures do not include fixed charges on either new or old production plant, they nevertheless indicate a price beyond which the distribution company can well afford to make at least a portion of its gas requirements, up to the capacity of its facilities.

Just a few years ago, the Bureau of Mines made tests and designed facilities for the production of oil from oil shale. Researchers interested in the cost of producing gas from such oil computed that, with but small changes from known techniques, it should be possible to build gasification facilities, manufacture gas and transport it from Colorado to the Pacific coast at a delivered cost, including fixed charges, of approximately 60 cents to 65 cents per Mcf. The amount of oil shale in the United States is tremendous and processes of this nature await but the proper price incentive to be started.

In the final analysis, partial gasification of coal appears to give the most promise of a practical low-cost substitute for natural gas. Coal has the advantage of being located in considerable volume hundreds of miles nearer to the major markets than the gas of the Southwest. It has been stated by authoritative sources that presently known techniques would permit the gasification of coal at the mine at a cost, including fixed charges on the production facilities and a reasonable price for the coal, of approximately 65 cents to 75 cents per Mcf of natural gas equivalent and that techniques that should be susceptible to research in a period of some five years or so should bring this down to around 59 cents per Mcf. It would therefore appear that competition may arise near the major markets, which will place a definite ceiling on the prices at which pipelines can sell natural gas to the distribution companies at the city gates.

Third, the distribution companies are subject to competition from other fuels at the point of utilization. The principal present sources of such competition are electricity, oil and coal. As yet, the competition from electricity has been for customer uses requiring relatively low energy volumes, such as refrigeration, some cooking, and water heating to a lesser degree. Except in areas with extremely low electric rates, electric space-heating competition has been of a minor nature, although investigations go forward on many fronts in the electric industry concerning both electric panel heating and the more efficient, though more complicated, electric heat pump. It is of interest that there is considerable thought now going on in the gas industry toward the development of a gas driven answer to not only the heat pump but also to a hitherto largely electrical market—summer air conditioning.

In considering electric competition it also should be noted that the marketed production of natural gas in the United States in the year 1953 represented, in terms of energy, more than five times the total electric energy produced in the country that year. Even should price competition indicate the replacement of gas by electricity for all conceivable uses, the mere task of increasing electric production and distribution five fold over present levels would prove a powerful deterrent to the displacement of gas. However, a change in the competitive relationship between natural gas and electricity could result in the shifting of business, which, in turn, would create very real competitive price ceilings for the gas distribution company.

The principal competition for domestic space heating has been between gas and oil. The premium fuel, gas, generally has been priced below oil during recent years although, as is shown by experience in some areas, it is able to compete favorably at some margin above oil. Studies have shown a clear correlation in any given area between the use of gas for space heating and the relationship between the prices of oil and gas. In this area of competition, a very definite ceiling for gas prices exists, and in many parts of the country the relationship between gas and oil prices is approaching

"It would appear that competition may arise near the major markets, which will place a definite ceiling on the prices at which pipelines can sell natural gas to the distribution companies at city gates."

that ceiling. Where oil is the competition for industrial gas, the line of demarcation is very sharp and even the smallest differential in favor of one fuel over the other may cause an overnight shift of sizeable markets to the lower-priced fuel. Here, again a definite competitive limit exists.

With regard to coal for domestic use, there appears to be no such direct correlation between price and use, for coal and gas, as exists between oil and gas. Here, the domestic customers' desire for fully automatic clean modern heat appears to far overshadow the question of price, and within rather wide limits it may be said that gas and coal are not truly competitive for domestic space heating. Where coal is used for major industrial purposes in competition with gas, however, the same sharp limit appears as with industrial oil. Competition in the industrial field is real and its effects are immediate whenever more heat units may be obtained per dollar by the use of industrial coal in a modern efficient installation than by the use of gas.

None of the forms of energy presently competing at the point of utilization has a static price structure and, while temporary shifts may occur in the interrelationship between the prices for gas, electricity, oil, and coal, these dislocations cannot long remain without having a marked effect on the shift of markets from one source of energy to another. It should be noted in passing that the overall trend of economy affects all of these energy forms as to price.

Lastly, the competition of natural gas with other energy sources which may have future significance carries us well into the field of speculation as to what such future energy sources will be. With atomic energy a growing reality and atomic power plants actually under construction in the world today, this energy source now appears as an alternative means for the generation of electricity. There is always the possibility, however, that direct application of atomic energy to utilization functions may come with the passage of time and form a real source of competition to all of the four present common forms—gas, electricity, oil and coal. There is the further possibility that a simpler and more efficient means of harnessing solar energy may be devised, which will enable us to tap a virtually unfailing energy source which is not tied to a so-called "wasting asset."

It is the belief of many students of future energy requirements that the growing requirements of the nation in the next decades will be such as to require all the help we can get from these new sources to supplement the present common forms. These students of our country's future visualize growth of energy requirements far beyond our abilities to meet all needs by the conventional means now at our disposal. The problem thus becomes one of supplementing present energy sources, rather than displacement of one source by another.

From the transmission and distribution standpoint, it should be noted that the movement of fluids, either liquid or gaseous, through pipes is the most economical means known today for the bulk transfer of energy. As long as the gas transmission and distribution industries can find adequate competitively priced sources of gas to transport and distribute, whether natural gas from the Southwest fields or gasified coal from the coal fields nearer the major markets, the gas transmission and distribution industries have the opportunity to dominate the function of supplying bulk energy to the nation's homes. Whether the gas distributed locally is natural gas or a substitute will depend on local circumstances and the point at which natural gas field prices ceiling off. Whether the transmission companies have a full place in the picture also seems to depend on whether the rate-making formulas applied to pipeline are ultimately modified to temper "cost" regulation with recognition of competitive value. In other words, it will depend on whether the rates permitted to be charged by the pipelines under regulation will recognize local competitive situations instead of being based principally on relatively inflexible formulas.

Regardless of the source of gas, it appears that the pipeline systems will continue to be the means of tying together and integrating formerly isolated gas markets. This will facilitate the construction of large central facilities for the manufacture of substitute gases, when price structures warrant it. This is particularly true for areas now served by pipelines that pass through existing coal mine areas. In this situation, underground storage will likewise be of great value since it will permit high load-factor manufacture, while at the same time allowing the distribution companies to meet the varying day-to-day demands of the ultimate consumers.

Looking back over this picture as it spreads out before us, it appears that, in spite of the confusion with which we are faced today, there may be a few valid conclusions that we can appraise at this time:

1. The gas industry has the opportunity to further develop and to retain a large portion of the home bulk energy market, if it plays its competitive cards properly.

2. The point of ultimate balance in the development of the home bulk energy market—that is the space-heating saturation at which we will ultimately stabilize—depends on the results of competition:

   (a) Between other energy forms at the point of utilization, for the distribution companies, and

   (b) Between natural gas and substitute gases, as to the producers.

3. Research promises increasingly competitive substitutes for natural gas.

4. Continuing regulation of production by the Federal Power Commission can alter the timing of producers' price increases, but in the long run cannot alter the broad competitive pressures that must influence the industry.

5. Recognition of the principle of value of service to the purchasing distribution company, to temper "cost" regulation of pipelines and thus ease the impact on the customers located farthest from the natural gas fields, would permit a more orderly transition from natural gas to substitute gases when economics call for such a transition.

6. With the gas business, as with so many things, "nothing is constant except change." The expansion of the natural gas business over the last decade has been phenomenal, and continues. The industry is alive to its problems and can be expected to meet them as they arise and go on to continuing prosperity in our growing country with its ever-expanding energy demands. ■

What do gas executives think about the Phillips-Panhandle situation? Their comments will be found on page 122.

What constitutes a sound main extension policy?

With the constant widening of gas systems into new, scattered suburban developments, main extension policies that once were adequate may be completely unsatisfactory under today's conditions. In a broad study of utility policies, the author found basic divergences of opinion and practice, as well as alternative plans that appear to him to be sound.

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THE rapid expansion in natural gas service that the past few years has witnessed has brought about many new problems, not the least of which is that of carrying out a policy relative to customer gas main extensions. Service areas are constantly widening from the closely knit city core to more scattered suburban developments. Main extension policies that once might have been adequate must now be re-examined for possible new answers to the question—

What constitutes a reasonable expenditure for extensions?

In order to find some possible answers, let us summarize and criticize existing and theoretical extension policies, examining them in the light of allowable plant supported by revenue and considering the ramifications of the apportionment of excess plant and refunds for subsequent additional revenues.

A gas utility is a natural monopoly. In return for the granting of this monopoly, a utility is logically required to serve the steady growth and expansion of the community. Where development is remotely located and unrelated to community development, the utility must be prepared to meet requests for service on a basis equitable to the applicants and which will not be detrimental to the operations of the utility as a whole. The problem, therefore, centers around the establishment of a definition of what constitutes a reasonable expenditure for extensions.[1] In all instances the extension of facilities involves the relationship, not only between the prospective customers and the company, but also between the prospective customers and the existing customers. The utility seeks to protect itself and its existing customers by protecting itself from a deficiency in revenue irrespective of whether this deficiency is because of excessive investment or scant revenue.[2]

Scant revenue and excessive investment are merely two sides of the same coin. Revenue and investment are both dependent variables. The return on investment is dependent upon the revenue received. Therefore, it follows that any increase in revenue will support additional plant investment. Any excess plant required beyond that which will

[1] L. R. Nash, *Economics of Public Utilities*, second edition. (New York: McGraw-Hill Book Co. Inc., 1931.)

[2] L. R. Nash, *Public Utility Rate Structures*. (New York: McGraw-Hill Book Co. Inc., 1933) p. 314.

Definitions

In order to standardize terms used throughout this study certain terms are defined below. Although taken from the procedures of one company,[3] these definitions are essentially used throughout the industry.

Applicant. Any person requesting service from the company.

Customer. Any person supplied with gas service by the company for use in a single enterprise on a single premise.

Mains. High, intermediate and low pressure gas pipes extending from town border stations or main line connections located in streets, alleys, highways, public ways and rights-of-way, through which gas is ultimately distributed to customers.

Services. Supply pipe extending from distribution main to inside face of first building wall that the pipe passes through or under, where company incurs cost installed or assumes full responsibility for operation and maintenance of said pipe.

[3] Public Service Co. of Colorado, *Rules and Regulations, Natural Gas Service* (Colorado Public Utilities Commission, Oct. 1, 1949) pp. R4-R6.

be supported by the revenue received must be so apportioned among the applicants as not to impair the earnings of the utility over the long run. In the gas industry, excess plant takes the form of main extensions.

One of the earliest extension policies in the United States was written in New York City in 1823.[4] It stated that the company would lay sufficient pipes to light homes and street lights in Broadway from the Battery to Grand street. The company was to provide pipes to each street light and the city to furnish lamps and fittings for connections to the service.

It was in England that one of the earliest written laws was made establishing exact amounts of pipe to be laid by the company involved and the procedure to be followed for excess main or service. The Gas Works Clauses Act Amendement Act of 1871 to the Gas Works Clauses Act of 1847 provided for main extensions of 25 yards and service extensions of 30 ft with any excess to be laid by the applicant.[5]

The early extension policies were predominantly based on a definite footage allowance. Such extensions of 100 ft cost approximately $100 and yielded an average annual revenue of $45.[6]

Another common policy, which is similar to the footage basis, provides for free construction equal in amount to some factor times the estimated annual revenue to be received from the proposed extension.

A third basis for extension is a dollar basis, which grants an applicant a predetermined amount of construction on a monetary basis.

A fourth method practiced is the allowance of a specified amount of construction based on the size and type of appliance or appliances to be connected.

It is extremely difficult to present a complete comparison of policies now existing in utilities. All utilities seem to have the same objective: to keep expenditures for extensions reasonably related to gross and net earnings. However, there are almost as many methods and procedures utilized as there are companies.[7]

Table 1 shows a partial breakdown of policies currently in force in some utilities throughout the United States. Each

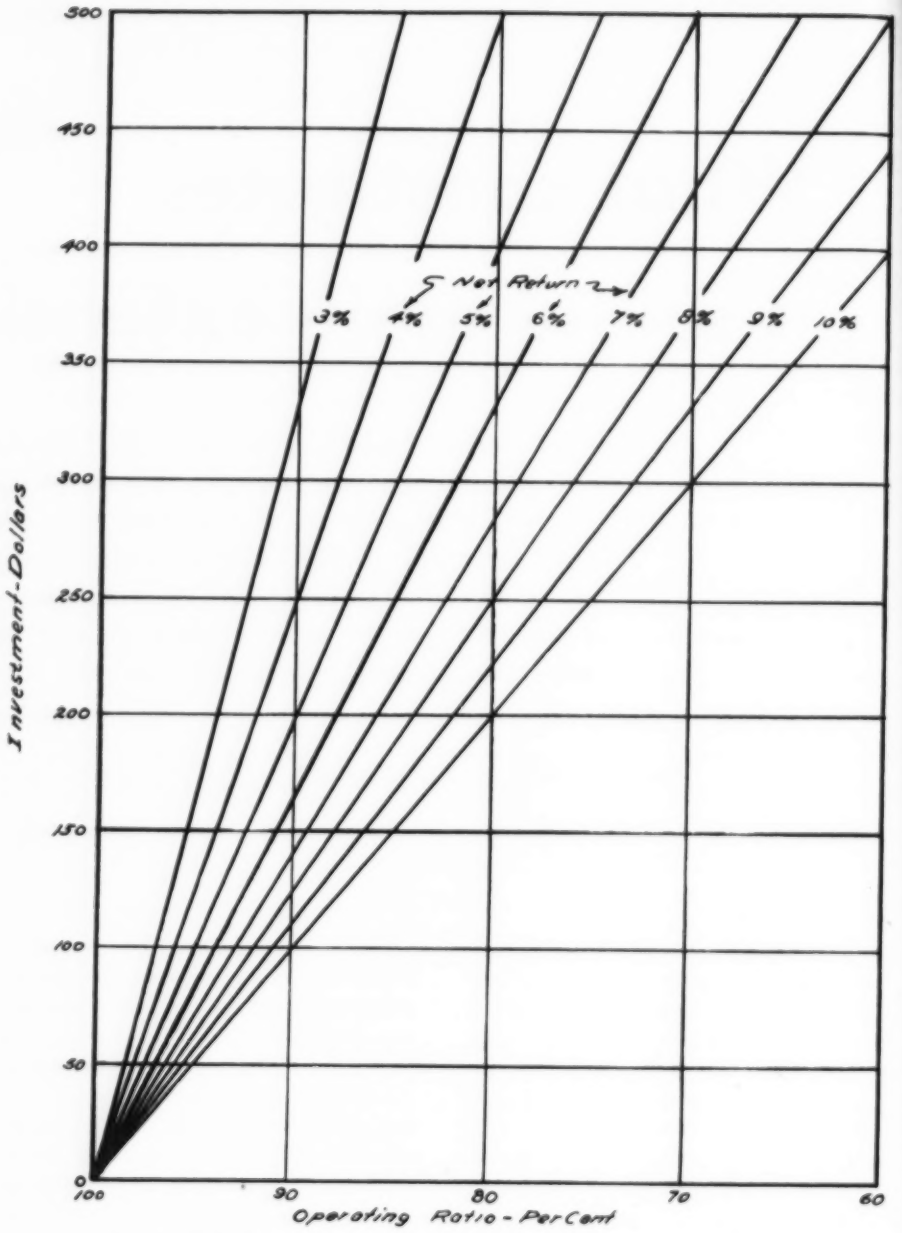

Fig. 1. Net return on investment for each $100 of gross revenue.

of the major policy types outlined above is shown on this table and will be more fully discussed on the following pages.

Footage basis. It will be noted on *Table 1* that a majority of companies shown have a footage allowance for free construction. Mr. Martin[8] found in his study that although the general practice is to have a definite amount of pipe that will be run free to a customer, the amount varied from 62½ ft to 200 ft of any size necessary.

In order to compare the free allowance on a footage basis, rate structures and construction costs must be taken into consideration. However, it would involve a stretch of the imagination to assume that such a footage allowance can be equitable to both the applicant and the company when it is realized that rate structures are comparatively stable and nonfluctuating as compared to construction costs.

One utility provides for a footage allowance of 100 ft of low pressure main and 200 ft of high pressure main with pound per square inch denoting the breaking point. In the present realm of technological advance in pressure regulation and control, such a policy would seem to be constantly changing, or in a state of flux within different service areas of the same utility.

Revenue basis. Shown in *Table 1* are seven companies whose extension policy is based on an estimated annual revenue. In addition, eight companies

[4] Louis Stotz and Alexander Jamison, *History of the Gas Industry* (New York: Stettiner Bros., 1928) p. 22.
[5] Walter Hole, *The Distribution of Gas*, 4th Edition (London: Benn Brothers Ltd., 1921) p. 3.
[6] L. R. Nash, *The Economics of Public Utilities*, First Edition (New York: McGraw-Hill Book Co. Inc., 1925) p. 383.
[7] American Gas Association, Unpublished Report of the Bureau of Statistics, 1951.
[8] D. S. Martin, *Policies for Extension of Gas Service to Fringe Areas*, American Gas Association, 1950, p. 1.

base the free allowance on a footage basis and/or a revenue basis. Here again no conformity was encountered. Mr. Martin[9] in his study found variations in the basis for full allowance ranging from twice the estimated annual revenue to four times the estimated annual revenue. In my study I have found variations from one-and-one-half times the estimated annual revenue to four times the estimated annual revenue. In an earlier study[10] it was stated that the normal cost of distribution facilities approximated $2 for each dollar of annual revenue.

This policy, while providing equitable treatment to all customers and the company as far as construction cost fluctuations exist, does not protect either one in the event of operating cost fluctuations nor does it protect the company for other plant increases necessitated by the extension such as distribution system reinforcement, pressure regulator stations, etc. This, in effect, could be construed as having a discriminatory effect on the existing customers or the company.

Dollar basis. A third method of determining the free allowance is that of the dollar, or monetary, basis. In my study I found six companies with such a policy. Mr. Martin[11] found but one company with a monetary allowance.

This type of policy is no doubt equitable to the applicant and the company where construction cost fluctuations are involved. Whether this policy is equitable to applicants and existing customers is beyond the scope of this study. Such items as operating expenses, and tax structures as well as rate structures would enter into the analysis to determine if the allowance followed a fluctuation nearly coincident with general business activity.

This policy does not allow extra construction for large users and thus penalized some classes of customers. However, some companies follow a policy of a monetary allowance for residential and small commercial customers with a revenue allowance for large commercial applicants.

Superficially it would appear that this policy would not adhere to all the prerequisites of a good policy but in equality of treatment would approach that of the revenue basis.

[9] D. S. Martin, *loc. cit.*
[10] L. R. Nash, *Public Utility Rate Structures* (New York: McGraw-Hill Book Co. Inc., 1933) pp. 70-71.
[11] D. S. Martin, *op. cit.* p. 2.

Appliance basis. The fourth method for determining the free allowance is on the appliance basis. This method is found predominantly on the west coast. Such policies are quite complicated. For purposes of illustration the terms of one of these policies[12] is shown in *Table 2.*

This policy is subject to the same criticism as the previous footage allowance in that no provision is made for variations or fluctuations in construction costs.

This company is currently revising the regulation to provide for annual adjustment of allowances based on construction costs incurred over the past year.

The policy would be at best cumbersome to administer, thus increasing the total operating expenses, and could possibly be discriminatory to existing customers in the form of the rate structure.

Various formulae have been developed by public utility economists to determine what free allowance should be granted applicants. (For examples of the three theoretical formulae, see the box on page 55.) One such formula has been developed for electric extensions[13] but the author says it is applicable to gas main extensions.

He started with his formula for a "proper" operating ratio:

$$\frac{I}{E} = \frac{100 - R}{10}$$

and from this formula developed the following extension formula:

$$\frac{i}{e} = \frac{100 - K_1 R}{10} - \frac{K_2 K_3 I}{E}$$

where

i is the allowable free investment in new extension (mains only).

e is the estimated annual revenue from the new extension.

R is the operating ratio (total expenses divided by the gross revenue).

I is the total investment in present plant.

E is the annual earnings (gross revenue) from present plant.

K_1 is the change in operating ratio.

K_1 is the incremental change occurring in the operating ratio on the new extension. The theory here holds that a new extension does not immediately bring about an increase in all expenses proportional to the overall operating ratio, i.e., the commodity cost will go up, but wages maintenance and administrative costs lag behind and do not increase directly and proportionally. Thus the operating ratio on the new extension may be only 75% of the overall company operating ratio, therefore K_1 would equal 75%.

K_2 is the extent of regular use of previously existing facilities. The theory here holds that a new extension utilizes only that portion of the total investment which is involved in feeder mains and those extensions which apply themselves to service of the new extension. As an example, a new extension may utilize only .9 of the total investment to serve the new extension, the other .1 of the total investment being involved in other extensions.

K_3 refers to the extent of temporary use of reserve capacity. The theory here holds that in any system there is some reserve capacity which is supported by existing customers but which can be utilized for the proposed extension without an increase in expenses, other than commodity. Thus a feeder main may be utilized at only .9 of capacity, there remaining a reserve of .1. K_3 would be equal to the extent to which the new extension would use this reserve capacity. If the new extension would use all the reserve capacity the factor K_3 would equal 1.

The conservative method of utilizing this formula would be to consider both K_2 and K_3 equal to unity.

This formula would be extremely difficult to administer. The factors K_2 and K_3 would be particularly difficult to ascertain. In the construction of gas distribution systems excess capacity is often built-in to care for future expansion. However, the exact percent of use on each segment of a system would be practically impossible to ascertain with any degree of accuracy.

Another theoretical policy has been advanced by the National Bureau of

[12] San Diego (Calif.) Gas & Electric Co., *Rule and Regulation No. 20 Gas Main Extension*, April 1, 1937.
[13] L. R. Nash, *The Economics of Public Utilities*, First Edition (New York: McGraw-Hill Book Co. Inc., 1925) pp. 378-383.

TABLE 1. SUMMARY OF GAS MAIN EXTENSION POLICIES (1951)

Type of Policy	Number of Companies
Dollar basis	6
Footage basis	27
Revenue basis	7
Appliance basis	2
Surcharge on excess	1
Deposit for excess	39

Source: See Appendix 1.

Standards.[14] This policy is based on an allowance to a residential customer equal to the total value of the distribution system divided by the total number of customers. For non-residential customers the amount of free construction per dollar of estimated annual revenue would be equal to the value of the distribution system divided by the gross annual revenue received by the firm.

No attempt will be made here to completely analyze this formula. It is sufficient to point out that two major difficulties can be seen at first glance. What would be the basis for determination of the value of the distribution system? The next point is that systems are built with excess capacity. Under the allowance as shown for residential customers the company is providing a free allowance based on this excess built-in capacity. If the system is a relatively new one with large excess capacity, the applicants get a larger amount of free construction, whereas applications for service from a system operating at near maximum capacity would receive a lesser amount of free allowance.

A third theoretical formula is as follows:[15]

$$d = \frac{100r\ (1 - Q)}{F\ (1 + \frac{1}{S})}$$

where

d is the cost of the new extension.

r is the estimate annual revenue from the new extension.

Q is the operating ratio.

F is the annual fixed charges in percent on the total investment of the utility in the existing distribution system.

S is the ratio between the increase in the distribution system and the increase in other facilities, which would include all plant increases not carried in the distribution plant.

This formula seems to be the most practical of the three analyzed. All items required are available from company records. Provisions are included to care for construction cost fluctuations. Thus the allowable free construction could be calculated monthly or annually.

For simplification, an average revenue could be obtained for residential and small commercial applicants and actual free allowance could be calculated for large commercial applicants.

This method would protect the company and the existing customers. The applicants would be paying their way in the same manner as the existing customers and would pay only to the extent of the facilities which were dedicated to their use.

A further simplification of a method of determination of allowable free construction is outlined below. I have not found this method proposed by any utility economists.

$$P = \frac{r(100 - Q)}{NR}$$

where

P = allowable free construction.

r = estimated annual revenue.

Q = operating ratio (including income tax) in percent.

NR = net return on investment in percent.

Such an extension allowance as proposed leans on the net return as the primary base point. Inasmuch as most states have regulatory bodies whose function, among others, is to fix the allowable rate of return on investment, this method should prove quite adequate.

Shown in *Fig. 1* is a graphic picture of the allowable investment per $100 of estimated annual revenue corresponding to various operating ratios and net return percentage. It will be noted that this method presumes to connect new applicants on a basis of net return allowed by regulatory bodies. Operating ratios could be calculated at any period of time so designed by management or regulatory bodies. The problem of utilizing such a method would probably involve considerable selling by regulatory bodies.

It will be noted in *Table 1* that 39 companies require deposits for mains in excess of the free allowance. These deposits range from a nominal charge per foot to a cash deposit equal to the entire cost of the extension. As in the determination of free allowance, these deposits are based on a formula intended to protect the company and the existing customers in the event of deficiency of revenue. The deposit is also tempered by the extent of competition from electrical utilities.

The state of New York provides for a surcharge of 9% (return, depreciation, taxes, and maintenance) per year of the actual reasonable cost of the portion of the main extension in excess of

[14] National Bureau of Standards, *Standards for Gas Service* (Washington, D. C.: United States Government Printing Office, 1934) pp. 91-99.

[15] J. M. Bryant and R. R. Herrmann, *Elements of Utility Rate Determination* (New York: McGraw-Hill Book Co. Inc., 1940) pp. 420-421.

TABLE 2. APPLIANCE BASIS METHOD

For such bona fide applicants who will take service under general service rate schedules within thirty (30) days from the date the company is ready to render service, the company will install without cost, except as hereinafter provided, whichever length of gas main is the greater, either 150 ft of main for each such bona fide applicant, or the following lengths of gas distribution mains for appliances actually installed with permanent pipe connections:

(a) Each residential or small commercial customer using a standard gas range (excluding a hot plate only)	75 ft
(b) Each residential or small commercial customer using a manually controlled gas tank water heater	40 ft
(c) Each residential or small commercial customer using an automatically controlled storage or instantaneous gas water heater	100 ft
(d) Each residential or small commercial customer using a radiant-fire, gas steam radiator, single-unit circulating air heater or auxiliary gas space heater	40 ft
(e) Each residential or small commercial customer using a floor furnace or central heating plant of less than 75,000 Btu	75 ft
(f) Each residential or small commercial customer using a gas-fired central heating plant having an hourly burner capacity of 75,000 Btu	150 ft
And for each 1000 Btu in excess of 75,000 Btu an additional	1 ft
(g) Each residential or small commercial customer using a gas refrigerator	50 ft
(h) For large commercial customers having an estimated annual revenue of $40 or more: First $40 estimated annual revenue	150 ft
And for each $10 or major fraction thereof in excess of $40 an additional	50 ft
(i) For seasonal customers such as summer cabins, beach cottages or mountain cabins, or for any equipment used as standby or auxiliary to other equipment in which some fuel other than gas is used, allowances as set forth under (a) to (h), inclusive, shall be reduced 50%.	

the free allowance.[16] This surcharge is based on 4-in. main for low pressure distribution, 2-in. for high pressure distribution, or actual main size if consumption requires a larger main than above stated. This surcharge is paid ratably for each billing month, and continues until such time as the total customers on the extension times the free allowance footage is equal to the length of the extension or to one-fourth the cost of the extension, whichever is earlier. While the surcharge does not involve as large an immediate expenditure to the applicant, it does provide for long term payments inasmuch as no time limit exists for surcharge payments. The pioneer developer is penalized to the extent that he does not receive a refund for his efforts in pioneering new developments and extensions. A surcharge policy does completely protect the company against deficiency of revenue on investment.

The majority of utilities require an advance in construction cost deposit which is refunded as additional revenue is obtained. An example of this is found in the Public Service Co. of Colorado rules and regulations,[17] which read substantially as follows:

> For residential and small commercial service of a permanent character, the company will install $100 of gas main extension and/or reinforcement. All construction in excess of $100 per applicant shall be advanced by the applicants.
>
> If during the five-year period subsequent to construction, further applicants request service from the extension, the company will recalculate the new free construction allowance and construction deposit required. Each new applicant will be required to deposit an amount equal to the construction deposit divided by the total number of applicants plus customers.
>
> For each additional new residential or small commercial customer connected directly to the gas main extension, the company will refund to the customers having made a deposit for the extension the sum of $100 plus the deposit made by the new customer, the refund to be prorated among the customers having made deposits. In no event will the total amount refunded be in excess of the original amount deposited by a customer or customers.
>
> No refunds shall be made for the connection of large commercial or industrial customers.
>
> For each subsequent gas main extension to an extension having unrefunded con-

[16] State of New York Public Service Commission, *Rules Relating to the Installation of Mains, Services, Connections and Facilities and Extension of Gas Corporations* (New York: Public Service Commission, 1945) Rate 3.

[17] Public Service Co. of Colorado, *op. cit.* p. E3, E4.

How the three methods for determining free allowance would apply to a given main extension situation

Present system investment $400,000
Operating ratio 85%
Gross revenue $160,000
Estimated annual revenue from proposed extension $400
Number of customers on new extension 4
Estimated cost of new main extension $500

METHOD 1

$$\frac{i}{e} = \frac{100 - K_1R}{10} - \frac{K_2K_3\ I}{E}$$

i = allowable free main construction.
e = $400, estimated annual revenue from the proposed extension.
K_1 = .75, change in operating ratio applicable to new extension only.
R = 85%, operating ratio for overall system.
K_2 = .9, the portion of the existing system utilized to serve the new extension.
K_3 = 1.0, the extent to which the new extension will utilize existing reserve capacity.
I = $400,000, present plant investment.
E = $160,000, gross annual revenue.

$$\frac{i}{400} = \frac{100 - (.75)\ (85)}{10} - \frac{(.9)\ (1.0)\ (400{,}000)}{(160{,}000)}$$

i = $550 allowable main extension

METHOD 2

$$d = \frac{100r\ (1 - Q)}{F\ (1 + \frac{1}{S})}$$

d = allowable free main construction.
r = $400, estimated annual revenue from new extension.
Q = 85%, operating ratio for the overall system.
F = 13%, annual fixed charges on the overall system.
S = (a) increase in distribution system plant.
(b) increase in other plant accounts.

(a) increase in distribution system plant
$500 cost of new extension
460 services, meters and regulators for new customers
$960

(b) increase in other plant accounts
$1 (use as a token amount)

S $\frac{960}{1}$

$$d = \frac{(100)\ (400)\ (1 - .85)}{13\ (1 + \frac{1}{960})}$$

d = $461 allowable free main construction.

METHOD 3

$$P = \frac{r(100 - Q)}{NR}$$

P = allowable free construction (total plant).
r = $400, estimated annual revenue from the new extension.
Q = 85%, operating ratio on the present plant.
NR = 6%, net return on investment.

$$P = \frac{400\ (100 - 85)}{6}$$

P $1000 total allowable free plant
Less: 460 services, meters and regulators for four customers
$ 540 allowable free main construction allowance.

After World War II, Mr. Lancaster worked part time in the gas engineering department at Public Service Co. of Colorado from 1946 until 1948, when he finished work on an engineering degree at the University of Denver and went to work full time for the company. In 1950 he was recalled to the army for two years. Since 1952 he has been an engineer in the distribution division.

struction deposits, the company shall refund $100 to the original depositors irrespective of the number of new applicants on the new extension.

Extensions and/or reinforcements to serve large commercial or industrial customers shall be by individual contract.

Assuming $100 gross revenue for a residential applicant and referring to *Fig. 1*, it can be seen that at an operating ratio of 87% and net return of 6% the allowable plant is approximately $215. This is not unreasonable assuming $100 main plant addition and $115 plant in service, meter and regulator, and other main plant.

The deposit and refund policy provides equitable treatment for customers and applicants alike by equalizing deposits and enabling each customer an opportunity to recoup his deposit.

Two fallacies appear most evident in the deposit and refund policy. The first fallacy is that the customers receive only $100 refund for an extension to their extension, irrespective of the number of applicants on the new extension. The second fallacy arises from no refund for the connection of large commercial or industrial customers.

With particular regard to the first fallacy, i.e., a limit of $100 refund for an extension to an extension, it might well be pointed out that bookkeeping involved in accounting for extensions to extensions can rapidly become a burdensome task, which would defeat the purpose of the refunding plan owing to the expense in accounting.

A possible solution to this problem would be to continue the present refund policy with the following additional provisions: Wherever sufficient customers have been connected to an extension to fully refund construction deposits on the second extension. As further customers are connected to the extension, the company shall refund $100 for each customer to the customers having outstanding refunded deposits on the previous extension, such refund to be prorated among the customers in accord with the amount of deposit outstanding.

The second fallacy concerns itself with large commercial and industrial customers. For the time being, industrial customers can be eliminated from consideration as in most instances such customers are usually given a special rate and are curtailed as deemed advisable by the company.

Large commercial customers, however, are firm gas customers as are residential. It is therefore reasonable to assume that extensions and refunds should be based on a policy similar to the residential and small commercial policy.

Extensions to serve large commercial customers can be based on an anticipated revenue basis, following the schedule in *Fig. 1*.

The above addition to the residential and small commercial policy would then place all firm rate customers on a similar basis, i.e., the allowable extension based on anticipated revenue, and the refund based on the additional revenue from additional customers.

This outline of deposit and refund policies is commensurate with the majority of current policies in the United States subject to minor variations.

It is quite evident from current policies in existence that no common basis for companies can be found. The variations are so great as to defy statistical correlation or analysis.

With the exception of the surcharge policy, practically all utilities require deposits on construction in excess of free allowance, which is based usually on a revenue basis of some type.

The surcharge policy provides maximum security for the utility's investment. However, no provision is included for refunding of deposits.

I believe that an adequate policy should be on a revenue basis, considering operating ratio and net return. Such a policy might be difficult to accomplish because of the resistance of utility management. All firm rate customers should be on the same policy basis.

Such a policy as outlined should cover the majority of extensions. However, should special occasions arise where the extension is of such a speculative nature that the company will be subject to a long range deficiency of revenue and return on investment, a special contract based on a surcharge should be applied.

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APPENDIX I

List of companies and regulatory bodies whose policies were used in the accompanying report

1. Colorado Public Utilities Commission.
2. Public Service Co. of Colorado, Denver, Fort Collins, and Grand Junction.
3. Pueblo (Colo.) Gas & Fuel Co.
4. Cheyenne (Wyo.) Light, Fuel & Power Co.
5. New York Public Service Commission.
6. Indiana Public Service Commission.
7. Brooklyn (N. Y.) Union Gas Co.
8. Central New York Power Corp.
9. Consolidated Edison Co. of New York Inc.
10. Central Illinois Light Co., Commonwealth and Southern Corp., Jackson, Mich.
11. Consumers Power Co., Commonwealth and Southern Corp., Jackson, Mich.
12. Pennsylvania Power & Light Co.
13. Louisiana Power & Light Co.
14. Northwestern Ohio Natural Gas Co.
15. Ohio Fuel Gas Co.
16. The Peoples Gas Light & Coke Co., Chicago.
17. Philadelphia (Pa.) Gas Works Co.
18. Washington (D. C.) Suburban Gas Co.
19. Alexandria Gas Co., Washington Gas Light Co.
20. Rosslyn Gas Co., Washington Gas Light Co.
21. Superior Water, Light & Power Co.
22. United Gas Corp. (Louisiana, Mississippi, and Texas).
23. Philadelphia Electric Co.
24. Public Service Gas Co., Newark, N. J.
25. Wisconsin Public Service Corp.
26. Equitable Gas Co., Pittsburgh.
27. Northern States Power Co. of Wisconsin.
28. Rochester (N. Y.) Gas & Electric Co.
29. Washington (D. C.) Gas Light Co.
30. Washington of Maryland.
31. Louisville Gas & Electric Co.
32. San Diego (Calif.) Gas & Electric.
33. Cincinnati Gas & Electric Co.
34. Mississippi Power & Light Co.
35. Connecticut Light & Power Co.
36. Southern California Gas Co.
37. Southern Counties Gas Co. of California.
38. Pacific Gas & Electric Co.
39. Greeley (Colo.) Gas Co.

Year	Gallons (in thou.)	% Increase	Domestic & Motor Fuel	% Increase	Industrial Misc.	% Increase	Gas Mfg.	% Increase	Chemical Mfg.	% Increase	Rubber Components	% Increase
1950	3,482,567	22.8	2,022,464	24.3	355,456		251,694	5.2	624,468	14.6	228,485	28.5
1951	4,227,275	21.4	2,456,804	21.6	269,408		281,692	11.9	844,507	35.2	374,864	64.1
1952	4,477,379	5.9	2,636,736	7.4	338,959	26.0	259,697	- 7.8	870,990	3.1	370,997	- 1.1
1953	4,932,009	10.2	2,977,418	12.9	374,233	1.04	222,430	-14.4	967,427	11.1	390,501	5.3
1954	5,134,000	4.1	3,250,000	9.2	382,000	2.0	207,972	-6.5	977,000	1.0	317,477	-18.7

Marketed production of liquefied petroleum gas, 1950-1954.

LPG industry continues expansion

LIQUEFIED petroleum gas, youngest brother in the family of fuel gases for general consumer use, continued to match the progress of its bigger brother, natural gas, stride for stride in 1954.

Such was the essence of the annual report released in mid-December by Phillips Petroleum Co. A solid, overall gain of 3.1% in sales volume, which brought total gallonage over the 5 billion mark for the first time in history, was shown in the statistical study, authored this year by George R. Benz, manager of the engineering department, Paul W. Tucker, technical representative in the engineering department, and W. F. DeVoe, assistant to the sales manager.

Best categories

Gains were racked up where they counted most. Combined domestic and motor fuel sales, the largest single category, showed a handsome 9.2% gain, more than matching a 19% nosedive in sales for the manufacture of synthetic rubber components and a loss of 6.5% in gas manufacture and utility sales. Chemical manufacturing applications were up 1% and industrial and miscellaneous sales increased 2%.

Boosts in domestic sales were not as impressive as they might have been, however, but a surprising jump in motor fuel sales helped carry this segment to the new high. A continuation of relatively mild winters bit into the peak load demands for home use. Summer sales showed a slackening in some respects, too: "the usually heavy irrigation load (fuel for the pumping units) did not start until late in summer, and sales of LPG for tractor fuel were off due to the extreme drought which sharply curtailed the use of tractors," the report stated.

The increases in motor fuel uses were termed "exceptional."

"Had they been treated separately, they would exhibit the largest single category increase. It is very difficult to separate the quantity of L.P. gas used as motor fuel from the overall domestic use. However, it is conservatively estimated that the sales of motor fuel increased 25% over last year. In other words, this use alone amounted to nearly 625 million gal. or more than 12% of the total sales. There are now over 2500 buses, 200,000 tractors and untold numbers of trucks and taxicabs operating on LPG. To get the total L.P. gas motor fuel market, one must add that which is used for irrigation, oil and gas well drilling, industrial tractors, lift trucks and refrigeration unit engines in cargo trucks

Point of interest

"Outstanding during 1954 in the LPG motor fuel phase was the interest in converting industrial tractors and lift trucks and engines driving over-the-road cargo truck refrigeration units."

Natural gas was largely responsible for the sizeable gallonage drop in utility uses—coupled with the mild winter. Peak shaving demand could have materially altered the picture had the winter called for heavier househeating use. "Natural gas line extensions or increased throughouts are, however, the major reasons for the drop," the authors point out.

In the field of industrial and miscellaneous uses, usurpation by natural gas was also felt. It is estimated that the total industrial load was off slightly, but miscellaneous uses offset this loss to give the 2% overall gain. In this latter category, industrial standby was mentioned as a particularly important market.

Production potential

In the matter of supply, the production potential continues to increase "despite curtailment in crude oil production and crude runs to still at refineries." Twenty new sources, with a production potential of 700 million gal., were completed in the year; 15 more with a 200 million-plus potential are scheduled for completion in 1955. Storage hit an all time peak. Underground banks now hold 212 million gal., 86% more than in 1953; and in 1955, an additional 250 million capacity is contemplated.

Appliancewise, LPG models showed a moderate to sizeable drop in sales—10% for ranges (down to 402,000), 3.7% for automatic water heaters (down to 274,000). Househeating appliances held up well, however; a total of 392,000 floor-space, and wall-type units shipped represented 28% of the total gas industry production of these models. ■

Part I in a Series

The New Gas Transmission and Distribution Piping Code

ASA—B31—SECTION 8

A background discussion by **FRED A. HOUGH**

The history and development of the code

PERHAPS the first and most important thing for all users of the Code for Gas Transmission and Distribution Piping to understand is the basic purpose and intent of all safety codes of the type we are considering here. All codes of this type are intended to be a statement of what is generally considered to be good practice within the subject industry, concerning design, construction, operation, and maintenance practices affecting public safety. Perhaps the true nature of such a code can be best explained by pointing out some of the things that such codes are not.

In the first place such a code is not a law. Since it is intended to be a statement of what is generally accepted to be good practice, it is naturally written by engineers, operators, and managers, who, as a result of their experience and their knowledge of the engineering and scientific principles involved, state what they agree is good practice from the standpoint of public safety. While members of the learned and highly respected legal profession greatly assisted individual members of the committee by explaining to them the legal significance of the code, they did not say or imply that active participation on their part in the drafting of the code was either necessary or desirable. Any such participation would be apparent to a court before which the code was presented as a statement of what is generally accepted as good practice in the industry and the effectiveness and acceptance of the code as such might thereby be impaired. On the other hand, if a code is developed by a competent and truly representative committee and is accepted by an overwhelming majority of the industry, as ours has been, it then has very important legal significance as a statement of what is generally considered to be good practice within the industry, and as such cannot be safely ignored regardless of whether or not it is adopted by reference as such a statement by government agencies having jurisdiction.

Since a code is merely a statement of what is generally accepted to be good practice, it cannot and should not attempt to say who is responsible for complying with such practice in any

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I HAVE accepted the invitation of the editors of GAS Magazine to write a series of articles on the new American Standards Association Code for Gas Transmission and Distribution Piping, ASA B31.1 Section 8. This code has been developed over a period of two and a half years by an aggregation of experts that is unique in the annals of gas industry technical committees because of the caliber of the membership and the wide scope of interests represented.

Because of the limitations that are of necessity placed on the language and material entering into a code, much valuable information and discussion that went on during the development of the code is not to be found within the finished document. The editors of GAS Magazine have felt that a series of articles presenting some of this background material, if published during the period when the code is first made available to the industry and is first being placed in use by the industry, would help those who are faced with the task of using the code and are endeavoring to bring company practices and policies in line with the code.

These articles are intended to call attention to the code itself and to specific items in the code, and to give background material concerning the thinking of the committee and some of the facts that led the committee to its conclusions. It is hoped that they will aid those who use the code to understand it and to recognize the significance of some of its provisions. On the other hand, these articles have no official status. They are not intended to amplify or interpret the code. The wording of the code must stand by itself. If users of the code wish official interpretations or clarifications, these can be had by writing to the secretary of committee ASA B31 at 420 Lexington Ave., New York 17, or to the committee in care of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

When, as a result of such inquiries, an official interpretation of the meaning of the code is given or revisions of the code are made, these are reported as cases and published in Mechanical Engineering and other magazines as they may desire to do so.

Those who want to be automatically notified of any such changes may subscribe (for a fee) to the ASME Revision and Interpretation Service pertaining to the Code for Pressure Piping.

Fred Hough was chairman of ASA B31, subcommittee 8, which developed the code. Formerly vice president of Southern Counties Gas, he is now a consulting engineer with the Bechtel Corp.

This first article will be confined to a discussion of the first two major subdivisions of the code—the Foreword and the section on General Provisions and Definitions. In these two sections the history of the code is recounted, the mechanism and procedures involved in getting official interpretations and revisions is described in detail, and the scope and intent of the code is defined.

specific case. For example: Let us assume that the code states that a pipeline, if installed in a certain type of location and under a specified set of conditions, shall be tested in a manner described in detail in the code. The code in doing this has stated what is good practice under the circumstances; however, the question as to who should make the test or who is responsible if a test is not made and a pipeline failure occurs as a result, is not a matter which the code can or should attempt to state. That is a matter of law and contractual relationships. Consequently the code committee has very properly avoided stating who should be responsible for carrying out a prescribed practice. It simply states the practice.

Furthermore, since a code states what is generally accepted good practice, it cannot include good practices that are not generally accepted. Consequently, new practices that some may feel are far superior to old practices cannot get into a code until the industry generally has been convinced that the new practices are acceptable. Generally speaking, to be acceptable a practice must not only be sound from a technical standpoint but it must be considered necessary in the light of the industry's experience, from a public safety standpoint. Because of these limitations, many superior practices, which under some conditions at least are highly desirable, are not prescribed in the code.

This brings us to a discussion of the significance of the word "minimum" in such statements as the following, which, incidentally, does not appear in our code: "The standards and specifications cited herein are minimum requirements." Many public officials and others have the impression that a minimum requirement is not necessarily an adequate requirement; consequently this wording has been avoided in Section 8 and has been replaced by the statement: "The requirements of Section 8 are adequate for safety under conditions normally encountered in the gas industry. Requirements for abnormal or unusual conditions are not specifically provided for, nor are all details of engineering and construction prescribed. It is intended that all work performed within the scope of this Section shall meet or exceed the safety standards expressed or implied herein." While this statement is longer, I believe it is better than the one involving the word "minimum," as it more clearly states the intent of the committee.

It should be emphasized here that our code was not written to be used as a specification. A specification covering for example, the construction of a pipeline, is intended to be an essential and integral part of a contract between the owner and the construction contractor. As such it spells out in detail the contractor's and the owner's duties under the contract. A specification is usually written with a specific job in mind, consequently it can be much more explicit concerning most items than the code can be. The code in many cases gives a number of options. The owner may not wish to give all of these same options to the contractor, but may wish to specify one. While one requirement in a construction contract might be that all work shall be done in compliance with the code, in most cases the owner will wish to spell out in detail which specific options available in the code are to be used, and in many cases may wish to prescribe more elaborate and expensive requirements than are prescribed by the code, because of special or unusual conditions of the job.

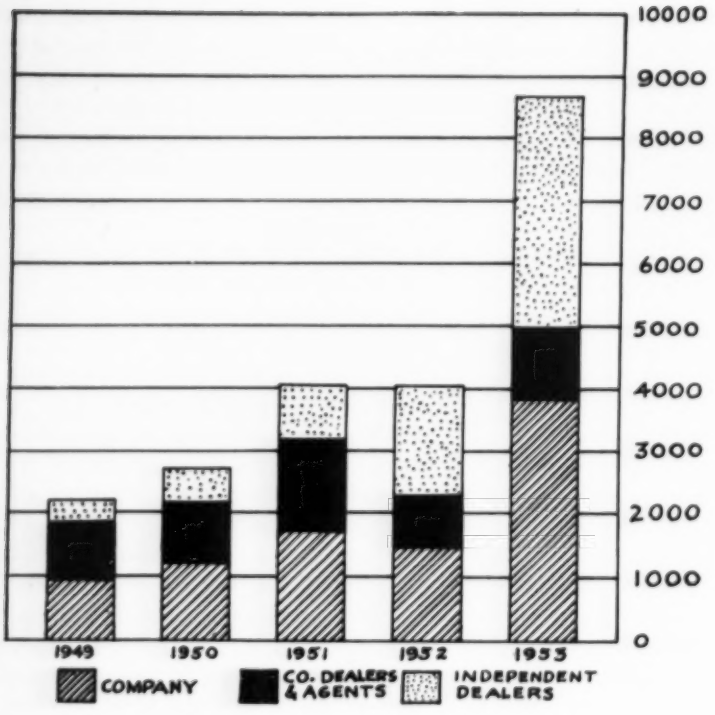
While talking about specifications, it would be well to discuss briefly the incorporation of standard specifications by reference in our code. Through the standardization activities carried on by the American Standards Association, the American Society for Testing Materials, the American Petroleum Institute, and others, many of the products widely used in American industry are made to conform with certain standard published specifications. Many of these specifications are incorporated by reference in our code. Sometimes people become confused as to the relationship between these specifications and the code. Perhaps the simplest general statement that can be made to clarify this matter is that a specification is intended to fully describe a material or piece of equipment and to specify the tests and tolerances to be applied to determine whether a given sample fits the description accurately. By the use of such a specification a purchaser can conveniently describe in great detail the material or equipment he wishes to order.

Our code, on the other hand, prescribes conditions of use to which items complying with standard specifications can be put. It is the responsibility of a code committee to examine each of the material and equipment specifications incorporated in the code to see to it that such specifications produce materials or equipment that are suitable for the uses for which they are to be put under the code and to see whether adequate standards of quality control are prescribed by the specifications to insure an adequate degree of public safety. While many specifications are drawn up with conditions of use in mind, this does not relieve the code committee of determining whether new uses or new conditions have arisen which make the specification inadequate.

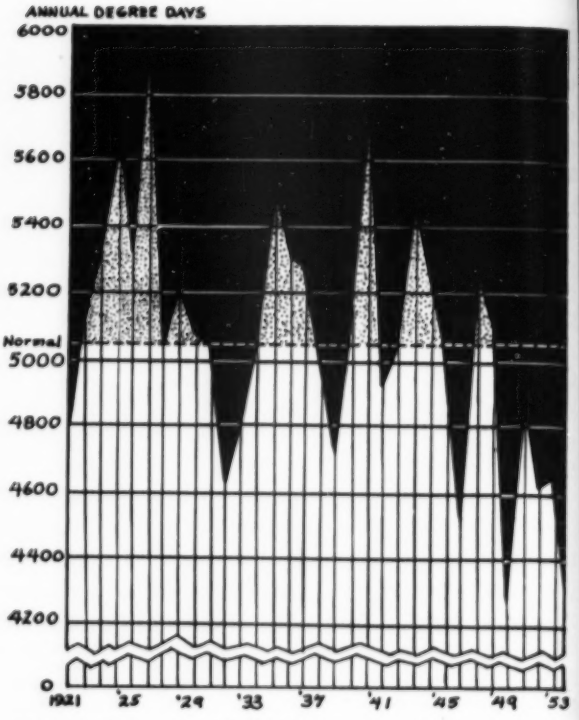
Paragraph 804.6 of the code states: "It is not intended that this code be applied retroactively to existing installations insofar as design, fabrication, installation, established operating pressure, and testing are concerned. It is intended, however, that the provisions of this code shall be applicable to the operation, maintenance and up-rating of existing installations."

The question of the possible retroactive application of the code by government agencies is one which frequently comes up. The code committee, of course, has no way of controlling the way in which the code is used; however, it should be clearly understood that in drafting this code the committee did not intend that it should be applied retroactively, except as stated above. Obviously everyone who spends dollars to achieve safety wants to make the greatest possible improvement in safety per dollar expended. Practices regarding design and construction which give added safety are prescribed by the code because the improvement in safety is commensurate with the cost. However, in many cases, if the same practices were prescribed for existing installations, the costs involved would be very great and out of all proportion to the improvement in safety achieved. It is evident, because of this fact, that no code written with the intent that it be applied only to new installations should be applied without modification and change, retroactively to existing installations. If there is need for improving the safety of existing installations, this matter should be considered as a separate problem and the most practical and effective solution developed for that problem.

There are significant comments to be made about the definitions of terms given in the section on General Provisions and Definitions; however, these will be left for later articles covering the specific sections of the code to which the definitions apply. In the next article we will discuss Chapter I of the code on Materials and Equipment. ■



Central gas heating units delivered.



New York weather (1921-53) in annual degree days.

Building an off-peak and fringe load

By **J. FRED EBDON** • Managing Editor

Increased supplies of natural gas during peak periods necessitate BU's development of off-peak business.

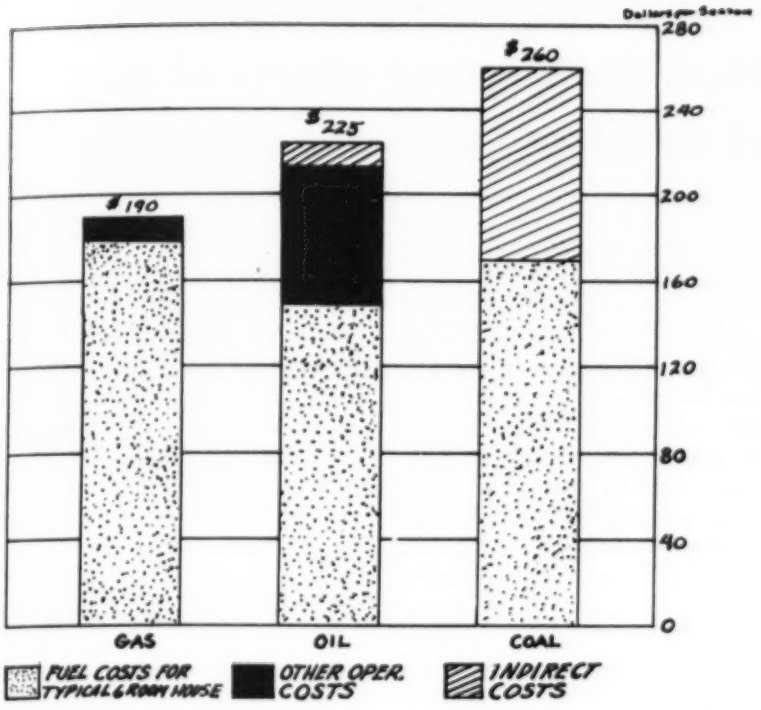
1. Natural gas opens the door to rapid expansion of peak heating loads

WITH the completion of additional natural gas transmission and storage capacity for the eastern markets, increasing volumes of natural gas are becoming available in the New York City area for domestic space heating during the peak months of December, January, February, and March. However, as pleasing as the ability to supply more peak gas for space heating is to the distribution companies, the problem of the differential between the peak and the off-peak loads is enlarged. The most logical solution to this problem is the development of off-peak and fringe-month loads.

Brooklyn Union Gas Co., serving Brooklyn and Queens, recognized this problem and started investigation into the development of off-peak loads in 1947. Since then, more and more natural gas has been available during the hard winter months; this has resulted in a program to expand market demands principally in residential, commercial, and industrial heating.

Advent of increased gas supply

The Federal Power Commission granted Tanscontinental Gas Pipe Line Corp., in late 1950, the authority to deliver 64 MMcf per day to Northeastern Gas Transmission Co. for distribution throughout market areas in New England. In the course of events, Northeastern was never able to take delivery of this natural gas, so the commission reallocated this delivery volume in late 1953. Of 64 MMcf per day, 56.1 MMcf was apportioned as follows: (1) 29.6 MMcf was committed to northern market companies, (2) Brooklyn Union was allocated 9.6 MMcf, and (3) 16.9 MMcf was reserved for several southern companies who had not proved their cases, so pending further



Estimated total cost of househeating. Heating equivalents used: 1095 gal. No. 2 fuel oil; 700 tons anthracite coal (hand fired); 125 Mcf gas at 1040 Btu.

disposition of this gas, it was allocated on a limited term firm basis and Brooklyn Union was able to pick up 5.3 MMcf. Twenty-eight percent of the remaining 18.9 MMcf was allocated to BU in April 1954.

This gave Brooklyn Union a natural gas supply during the 1953-54 heating season that totaled 90.3 MMcf per day. Also, a large manufactured gas plant capacity was available.

Storage programs

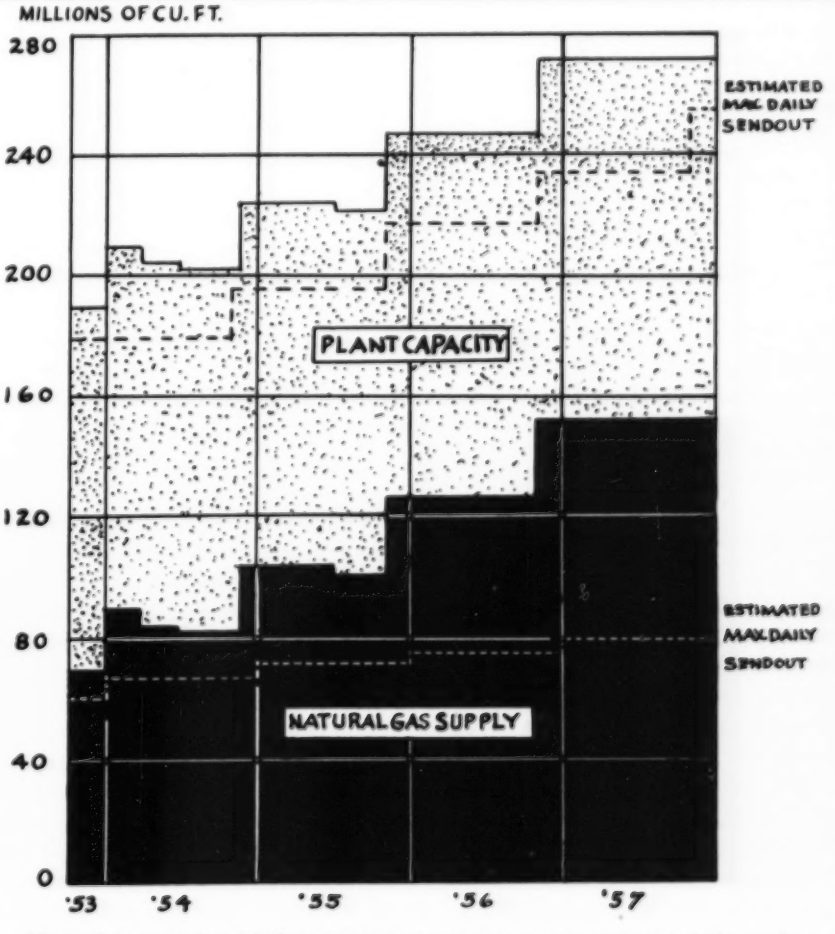
Texas Eastern Transmission Corp. is providing natural gas from storage to Transcontinental and its customers each winter, beginning Nov. 16 and ending April 15 of the following year, starting this season. Texas Eastern built a new 24-in. pipeline from its Oakford storage field, near Pittsburgh, to Lambertville, N. J., and Brooklyn Union is supplied a maximum of 22.5 MMcf a day with a seasonal maximum of about 2021.2 MMcf, from this storage project. This volume increases the gas that is available for peak-time heating and adds to the security for continuous service to ultimate consumers.

Tennessee Gas Transmission Co. proposed to bring 90 MMcf per day of firm gas to the New York-New Jersey market, beginning Oct. 1, 1955, and in its application for a certificate specified that an equal volume of natural gas will be available from peak storage capacity for the winter of 1956-57. Late in 1953, Brooklyn Union signed an agreement with Tennessee Gas that provided for 25 MMcf per day of the firm gas and an option to allow BU to purchase up to 25 MMcf of the peak storage capacity.

Heating load development

The residential gas heating market was just beginning to develop in Brooklynn's market area as recently as January 1954. In fact, the saturation was estimated at 12% of the residential market. With this in mind, the company started a strong promotional program to develop this potentially large load. The decision was made in this direction because of the improved profitability of househeating customers under natural gas operation, and the more direct advantage of this business bringing in the expansion and retention of other domestic utilization of gas.

Brooklyn Union added 8600 heating installations to its lines during 1953: this is the greatest increase in this type of service for any one year in this utility's experience. To do this, the company's salesmen were supplied a unique



Natural gas supply and plant capacity vs. average and maximum daily sendout. Average daily sendout excludes interruptible sales.

sales presentation and incentive plan. An "Estimated Total Costs of Househeating" chart (see page 00) was prepared. This chart took into account the extra expenses that go hand in hand with basic fuel costs. Such additional expenses as the indirect costs of cleaning bills, ash disposal service, delivery expense, etc., were added to the costs of fuels to which they were applicable. This study revealed that the true costs to heat a typical house during an average heating season were $190 for gas, $225 for oil, and $260 for coal. When these comparisons were pointed out to prospective customers along with the convenience advantage of gas, the reaction was highly favorable.

Several other sales tools were made available to those pushing the househetating campaign. Incentives, such as those that follow, were approved and applied to the program:

(1) *Oil burner allowance.* One of the most direct methods of obtaining part of the oil heating market was to offer a $50 allowance to anyone converting from oil heat to gas heat. About 1057 homes took advantage of this offer during 1953.

(2) *Proof of performance.* The company guaranteed its estimates for the costs of heating with gas to those customers who switched from other fuels. This offer assured the removal of gas conversion burners without charge to the customers if the actual fuel costs for one year, adjusted to the normal weather conditions, exceeded the company's estimates.

(3) *Credit.* Any prospective customer desiring to purchase a gas heating installation and/or any other gas appliance from Brooklyn Union or from any of the 1200 cooperating dealers acting as the company's agents, could finance his purchase through the company. In addition, BU financed any AGA-approved space or water heating equipment sold directly by independent dealers. About 65% of the total appliance sales were made on credit offered by this program.

(4) *Office sales program.* Employees were paid a stipend on delivery of appliances sold as a result of their leads. In 1953, more than 5000 appliances, representing close to $2 million, were sold under this plan.

The results obtained are an indication of what an aggressive utility can do with a dynamic promotional program.

2. How the adverse effects of peak load development were overcome

TO BALANCE the effects of the househeating-load program, it was decided that an off-peak load should be developed. The first step was a revision of the off-peak rate. This was filed with the appropriate commission on July 23, 1953 and became effective Aug. 24 of the same year. This rate was designed to add large-volume water heating, fringe space heating, and steam generation. (Fringe space heating is heating during the spring and fall, that is, just before and after the peak heating season.)

Brooklyn Union was particularly interested in the development of these loads because, as stated previously, they can greatly improve the overall load balance between winter and summer loads and they constitute a very sizable potential market. The characteristics of these loads means that most of them are applicable to apartment-type dwellings, and surveys indicated that there are about 45,000 apartment structures, representing about 500,000 dwelling units, in this distributor's service area.

This tied in well with the investigations of off-peak load bulding that were originated in 1947. The commercial sales section's part in this program began in 1949 and the five years of investigation went beyond the usual concept of a market study in that it encouraged development and pioneering of equipment, with emphasis on the reduction of first cost for such equipment.

Fuel door burners

One of the first areas for investigation was the application of gas-fired, fuel door burners to existing boilers in apartment buildings. The first burner tried for this purpose was a blower type. It was soon obvious, however, that the burner designed specifically for this application was much too heavy and expensive. The decision was made to use atmospheric burners with specially designed secondary air ducts that would supply air uniformly along the length of the burner. The particular design that was used worked out well, but after a year or two, the manufacturer indicated that he was no longer in a position to supply them.

During the period of these test installations (through 1950), much research had been done on the feasibility of firing space heating boilers with very low inputs, and utilizing these appliances to supply hot water service during the off-peak summer months. Input rates as low as 7% of the boilers' designed inputs were tried and found satisfactory for water heating, and it was also learned that with inputs of 50% of the rated values, fringe heating could be accomplished along with the water heating. With the relatively low input rates, burners did not have to be supplied with additional secondary air as there was generally enough air leakage around the boiler settings to provide adequate volumes for complete combustion. Consequently, conventional inshot atmospheric burners were found to be the best suited for this purpose.

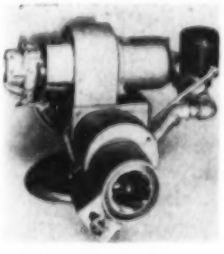
Fuel door burners of this type, large enough to supply the off-peak water heating and fringe space heating required in a building housing up to 20 family units, can be purchased for a rather nominal investment and weigh only 60 lb. The company is proceeding with the development of this load. The major problem that has presented itself is the method for changing the fixed flue-pipe damper during the spring and fall months.

Immersion-coil burners

Work on the large-volume water heating loads that are found in apartment houses and in miscellaneous commercial fields, developed in the direction of storageless, immersion coil boilers. Brooklyn felt that the failure to capture a larger part of this water heating load was one of its major weaknesses; perhaps this indictment might apply to other companies in the industry.

In order to encourage the use of immersion coil equipment for this application to a potentially large market, Brooklyn Union made an installation of a Viking Hydro-Twin booster water heater (an appliance using the immersion coil idea) in an apartment. This boiler was interconnected with the main space-heating boiler in such a way that the hot water from the latter boiler could be pumped over the coils in the

Methods for development of off-peak and fringe loads

EQUIPMENT	OBJECTIVES	APPLICATIONS
FUEL DOOR BURNER	1. Off-peak water heating. 2. Fringe season space heating. 3. Combination off-peak water heating and fringe space heating.	Low input atmospheric burners were applied to existing apartment house boilers originally fired with coal or oil the year around. These gas burners replaced the need for these fuels during the winter peak months.
IMMERSION COIL BOILER	1. Replacement of small coal-fired boilers used for off-peak water heating. 2. To provide a gas-fired off-peak water heating service and enable the same equipment to be used as a peak period water heater when inter-connected with a main space heating boiler fired with another fuel.	Installation of a water heater using the immersion coil principles eliminated the need for small, inefficient coal-fired water heaters during the summer months. Interconnection of the immersion coil gas-fired water heater with the main space heating boiler allowed the gas-fired unit to supply water heating during the summer; then, using hot water from the space heating boiler, it provided this service during peak months.
COAL POT BURNER	1. To convert coal pots used for apartment house water heating to gas firing with a minimum of expense.	A coal pot gas burner was devised and, in conjunction with a special baffle and simple pilot-flame powered controls, conversions were made to provide a healthy year-around water heating load.
COMBINATION OIL-GAS BURNER 	1. To economically convert existing oil burners to part-time gas firing for off-peak and fringe applications.	Oil burners were converted so that they could be fired with gas during seasons when the rates and supply made this advantageous. They were generally used for low input applications, and were installed on existing equipment for nominal cost.

water heating boiler during the peak winter months, and the connections between the two boilers could be valved off during the summer months so the space heating boiler could be taken out of operation. It was desirable to take the large boiler out of operation during the summer months because this type is relatively inefficient when compared with the operation of the immersion-coil boiler on the off-peak rate. With this piping arrangement, it was possible to supply the dwelling units with hot water during the winter months from the relatively large space heating boiler fired with low-priced coal or oil, rather than taking this service from a small coal-fired, hot water boiler fired with a more expensive grade of coal. This type of installation proved very satisfactory. It is termed a "generator hook-up."

Immersion coil, large volume water heating for apartments and commercial utilization is now out of the investigative stage, and can be supported on the basis of experience. Brooklyn Union has knowledge of more than 350 installation and these have shown that storage tanks are unnecessary for nearly all applications, including restaurants, apartment houses, and hotels. Storage tanks for these applications are now considered to be in the same class with the horse and buggy. BU is now developing the use of these boilers for supplying both heat and hot water for

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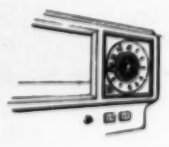

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WHITE SANDS

New 36″ range. Shown here with automatic oven timer. Two ovens: full-size oven and "Pastry" oven. Model CPD A3AX.

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Off-peak loads ... Engineers will continue to search for a solution to the coking problem

small, multiple-family buildings that house from 4 to 10 families. Until this boiler became available, it was necessary to sell a separate, volume water heater, which added expense that made the use of gas prohibitive.

Coal pot burners

Coal pot burners were the next target for investigation.* Many of these solid fuel-fired water heaters were in use within the company's service area. BU reasoned that the use of a burner that was designed to eliminate the need for rearrangement of water piping would allow the conversion job to be done economically. Also, the use of pilot generators would eliminate the expense of an electrician to make the $60 electrical revampment necessary. Brooklyn Union felt that this was another application for the knowledge gained through research into the low input, or increased ratio of heating surface to input, field.

First, the company purchased a standard coal pot and experimented with converting it to gas-fired operation. It was found that the insertion of a round stainless-steel baffle that forced the flue gases from the burner to pass through the annular space between the baffle and the coal pot could make the converted coal-fired appliance operate as a gas-fired unit that produced efficiencies about equal to AGA-approved, gas-designed water heaters. Investigations revealed that inputs of about 4000 Btu per hour per family were adequate as this rate of firing resulted in about 20 hours of low input operation, which reduced standby losses. About 400 of these converted units are in operation at this time, even though the best rate that can be applied to their gas consumption makes them operate, on a year-around basis, at a cost that is about 30% higher than the cost to customers for water heating gas in private houses. However, the customers that use the converted coal pots during off-peak periods only receive a more advantageous rate.

The primary reason that apartment house owners have purchased gas-fired, coal-pot water heaters, in view of the high rate applicable, is the convenience and savings that result from the elimination of the need for coal handling and ash disposal. A man hired to do this work is usually paid from $10 to $15 per month and may not be very dependable; or, if the owner does this work himself, it is messy, time-consuming, and burdensome.

Combination gas-oil burners

The investigation into the problems and equipment involved in the modification of oil burners, to allow them to be utilized as combination gas-oil burners, was started in 1950. The basic approach was the installation of a gas ring around the end of the blast tube on standard, high-pressure oil burners. This system has the advantage of making changes unnecessary in the operation of the oil burner or its controls, because the ring is simply fastened to the end of the blast tube and the oil-burner blower is utilized to supply the necessary combustion air. The gas ring, and controls for its efficient operation, were found to be readily available at a price that encouraged its acceptance.

The ring is available for about $140; this price includes burners up to 450,000 Btu per hour input, and this type of burner is particularly well suited for converting oil burners firing No. 2 oil. This is an important factor because of the large number of burners fired by this oil that are installed in Brooklyn Union's distribution area.

Two major problems presented themselves as work on these conversion burners progressed: (1) the short life of the stainless steel ring, which was unable to hold up under the high temperatures produced by the radiant heat emitted from the combustion chamber during periods when the burner was being fired with oil, and (2) coke formation from the small quantity of oil that was left in the oil burner nozzle, when the burner was taken off of oil operation, being subjected to radiant heat from the combustion chamber when the gas flame was brought into operation.

The deterioration problem seems to have been solved through redesign of the burner ring; however, the problem of the coking seems to be a difficult one and, to date, there doesn't seem to be a completely satisfactory answer to it. The engineers will continue their search for the solution. Some work is also being done to determine the advisability of converting oil burners that are being fired with the heavier oils, such as Nos. 4, 5, and 6.

Fringe heating

The possibilities for exploitation of fringe heating with low-input gas burners was mentioned in the discussion of fuel door burners. A superintendent of one of the buildings in which Brooklyn Union was doing some experimentation with fuel door burners, to be used for water heating during the off-peak period, wanted the company engineers to see if they could increase the input of the burners, or add more burners, so that enough steam could be generated to supply heat to the tenants during the fringe heating months of September and October. Naturally, this quickened the interest of the gas engineers, so they started increasing the input to this boiler in three or four increments by the addition of burners. They were not optimistic about the project for they felt that the low pressure steam would not be successfully distributed; however, they carried out the development and, in the end, switched to a blower-type burner to gain more input. Eventually, they were able to produce enough steam to supply adequate heat to the building when the outside ambient temperature was 35° F, and at a thermal input to the steam generator of about 50% of its rated value.

Experience has shown that in nearly all cases it is possible to provide adequate hot water service and heating during the fringe period with fuel-door gas burners delivering about 60% of a particular boiler's rated input. This has proved to work out well in apartment buildings housing from 8 to 42 families. Further investigation showed that enough low-pressure steam can be generated with only 50% of the rated Btu input to supply the needs of about three-quarters of this class of apartment buildings in Brooklyn's territory, but they feel that it is fortunate to be able to increase the input by another 10% when the additional energy is needed.

In apartment houses of this type, there is generally no suitable location for a thermostat, so to prevent wasteful use of gas, the gas engineers found it desirable to install both mechanical and electric time clocks set for two or three hours' operation. They provide operation that closely simulates that of the

*See *GAS*, January 1951, p. 30, "Why Consider Only Half Our Off-Peak Problems?" by H. B. Wilson, manager of Brooklyn Union's commercial sales section.

boiler when fired with coal, because it is generally the practice of the superintendent to fire the boiler for two or three hours in the early morning and for an equal period in the late afternoon. It should be understood, of course, that heating such as has just been described applies to only the fringe heating seasons, and these controls furnish only a partial answer to the problem of keeping the expense of gas firing in competition with the cost for other fuels. Another device, an outdoor thermostat, is being tested in connection with the fringe heating program. The manufacturer claims a considerable savings even when it is applied to coal operation, so when it is realized that the cost of this relatively expensive device is around $450, but that it can produce savings in both the gas and coal operating phases, it is hoped that these economies can amortize the control and burner costs quickly.

In the future, Brooklyn Union will recommend fuel door burners, designed to deliver 60% of boiler inputs, to customers desiring fringe heating installations. This low input program implies the use of low-priced equipment that can be handled by one man, and it assures that the equipment will not be used in extremely cold winter weather when the utility would probably be using its peak shaving equipment. For instance, at 0° F, with 60% input, most of the boilers involved would not be able to raise any steam pressure. Also, a prohibitively high rate penalizes the user during the cold months, thus discouraging use of this fringe heating during peak periods.

Deliveries

Brooklyn looks forward to the day when natural gas deliveries from Texas will be adequate to allow the apartment-house fringe heating business to be carried into the four peak months on a load-building basis. It is felt that this is not too far off; however, it should be understood that the boilers will still be fired at inputs that are about 50% of their rating, and this means that the boilers can be used only when the outside temperature is above 35° F. Further, only those oil burners equipped as gas-oil conversion burners will be involved, as they are the only burners used in fringe heating that can be switched from one fuel to the other in just a few minutes. Probably, a special rate will be worked out for customers with this type of equipment.

The introduction of fringe heating into Brooklyn Unions' off-peak load development program, formerly consisting of just water heating, was a substantial addition. For example, increased load estimates are about eight times greater when fringe heating is added to the water heating figures. This is because the consumption is increased about two and one-half times per installation and more installations are expected from the substantial shortening of the amortization period.

Off-peak loads ... Success requires formation of a separate working unit

Study of low efficiencies of oil firing under light load

It has long been suspected that oil burners are particularly inefficient at low-load periods. Fuel consumption data obtained from fuel oil suppliers indicated that about 1.75 gal. or 245,000 Btu per day are required to supply adequate hot water for a one-family house in the New York area. Brooklyn Union's records show that 100,000 Btu are required for the same purpose when gas is the fuel used. This great difference in thermal energy input, to do the same amount of work, is undoubtedly due to combustion efficiency differences in the amount of air passing through the boiler during standby periods. From experience in the commercial field, it appears that it can be stated fairly that oil is only about 60% as efficient as is gas for firing space heating boilers that are used to supply hot water to apartment houses during the summer months.

Conclusions

Most of the research work was carried out with money allocated by the gas company. The expenditures have been justified by data indicating profits accruing from the added loads will restore the money used in a very short time.

Brooklyn Union feels that a program such as this requires the formation of a separate working unit for its successful operation. Otherwise, responsibility will be divided, with the resultant lack of determination and enthusiasm to carry out the program. A single, well-knit unit increases the chance for success, particularly when the group is assured of proper backing and the necessary equipment.

To maintain its financial progress and healthy growth, and in view of the expected delivery of additional natural gas that will reach close to 130 MMcf per day beginning in November 1955, management of the company has squarely stated that it will sell the product on a competitive basis since there is no monopoly on the sale of any fuel in the trade area. To do this, the company will:

The future

(1) Continue to offer customers free adjustment service. Brooklyn Union is the only company in the metropolitan area that has this policy.

(2) Provide better service to all customers, whether it is in the field or over the counter.

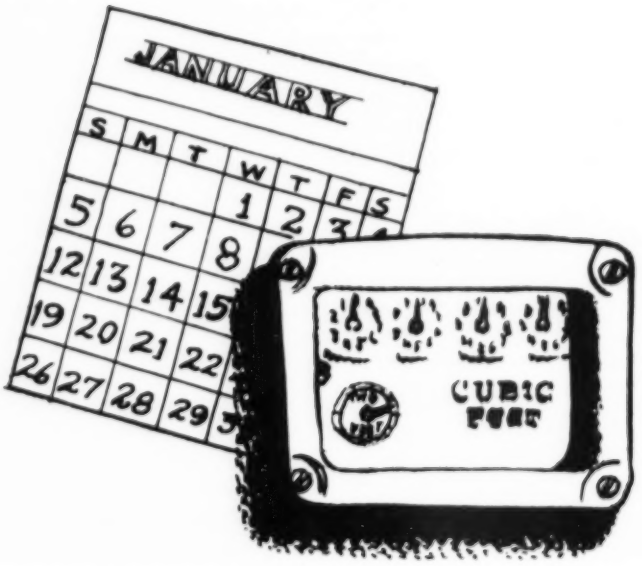
(3) Continue expansion of the househeating load.

(4) Increase the volume of interruptible sales, that is, the large volume sales that are used to fill in the valleys of the off-peak periods.

(5) Take steps to continue the steady growth in commercial and industrial loads.

(6) Increase sales of other summer and fringe loads, such as summer water heating in apartment houses, and fringe water and space heating.

What's the preferred basis for meter change-outs



AGE-OR MILEAGE?

The idea of changing-out positive displacement meters on a total-volume-of-gas-passed basis strikes the editorial staff of this magazine as being an idea that has dynamic potential. On the other hand, this idea may be just an interesting thought that has no realistic application. We decided to see what some of the top metermen in the nation think about the mileage change-out vs. periodic change-out question. Here are the results of a survey that posed this idea to the superintendent of meters of a number of companies distributing natural and/or manufactured gas.

By J. FRED EBDON • Managing Editor

A MAJORITY of the gas companies in the United States are changing-out meters on a periodic basis. In some cases this is due to provisions promulgated by regulatory bodies under which they operate, but in most cases it is felt that a periodic basis has the advantage of:

1. Relatively low cost of record keeping using present manual record and filing systems.

2. Easier preparation of a routine change schedule.

3. Reduction of internal corrosion when chemical action on working parts is a factor in meter deterioration. This would apply particularly to some manufactured gases.

4. Facilitating the scheduling of a definite number of meters for change each year. In effect, this aids in the preparation of the meter shop budget.

5. Allowing personnel to be used to change-out meters during seasons or periods that are slack. This might be very important in the case of a small company in which servicemen double as metermen.

6. Providing an internal maintenance period that more closely coordinates itself with the period for external maintenance.

Not all of the metermen surveyed are convinced that the periodic basis has any advantages or that it is the best system. A few feel that the mileage basis would prove advantageous, but this hypothesis is hard to justify or prove without actual experience. The premise that the age-change programs are the best is certainly sound from a historical standpoint. It reflects the periods in the past when the gas distributed contained many impurities that adversely affected the accuracy and period of service of meters; however, it does not eliminate thinking in terms of mileage change-out

programs in conjunction with the vast improvements that have been made in send-out gas and its distribution.

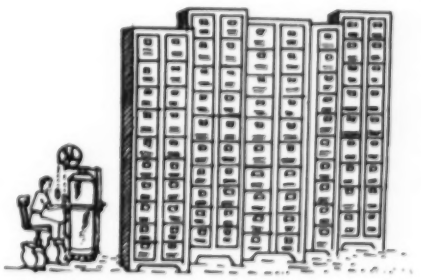
Experience has shown that the accuracy of present-day meters is quite good. In most areas, meters left on the line for full time of their periodic repair period prove to be measuring within the legal definitions of correct—as an average, probably well over 90% of the periodic meters prove-out as accurate on the in-test. Is this the optimum? Most metermen will not admit to being satisfied with their accuracy record—they feel that they are doing a good job, but most have aimed at a goal of 100% of the meters legally correct.

Generally, it is not known how much mileage our meters accumulate between repairs, and, as a result, there is usually no correlation of the parts needed for replacement during repair with the volume of gas passed. This seems a bit odd when it is remembered that the wear on the parts that need replacement actually was caused directly or indirectly by the passage of many cubic feet of gas through a meter. Could it be that we are changing some meters when they do not need repair, and that others are staying in service long after wear on parts has made them relatively inaccurate?

Let us consider the proposition that mileage basis has some merit. Under the mileage change-out system, it is possible that fewer change-outs per year would have to be made. This would certainly save some money. Also, those meters that are doing the most work would receive the most repair. In other words, the meters that pass the most gas will be repaired more often, and who can say but what this is actually merely a matter of preventive maintenance. In theory, meters that have passed the same volume of gas should show patterns of wear in the same parts—if these patterns were studied and data accumulated, some metermen feel that simplified flow patterns of repair could be devised. This, in turn, might mean increased efficiency at lower cost. In any case, it seems reasonable to assume that matterials handling equipment and mechanical devices could be more readily applied to a production line repair system that should result from a mileage-based change-out program.

Several people pointed out that a mileage system would greatly aid in sizing meters to suit the needs of customers. Records required would certainly reflect the growth or decline of customers' consumption. The difficulty lies in precisely evaluating the savings involved as most companies do not keep records of the money wasted when meters are detected to be over- or undersized.

The record-keeping associated with a mileage change-out program would be complex and expensive: therein lies one of the major disadvantages. However, the majority of the meter shops surveyed are using manual methods or semi-mechanical procedures, so perhaps the miracles of modern mechanical and electronic record keeping and data processing equipment have never been applied to meter shop operation. Perhaps with equipment of this type, the suspected high cost of record keeping to administer a mileage-change program could be reduced, but until this is determined, record keeping under such a program seems to be prohibitive.



The record keeping associated with a mileage change-out program would be complex and expensive: therein lines one of the major disadvantages.

The survey revealed that there is a wide difference of opinion among meter experts as to which change-out method produces the greater overall accuracy. In the first place, none can question the fact that gas meters will register with amazing accuracy (considering the investment involved) over periods of years if left undisturbed. On the other hand, metermen do not feel that we have reached the optimum, so work should be done to improve meter accuracy. Many feel that the conditions the meter operates under have as much to do with the accuracy as the length of time or the volume of gas passed, but under the mileage program, meter proofs should be more consistent. Others feel that the differential through the mechanism is the only substantial determinant of meter accuracy and are not greatly worried about time or volume. One company that has been changing a relatively small number of meters on a mileage basis has data that support the improved meter accuracy theory, but is not convinced that the proper mileage figure has been applied for each range of meter capacities; and the meter superintendent thinks that the smaller sizes should have a combination basis that would specify their change-out after passage of a certain volume or after they had been in service for a certain number of years, whichever occurred first.

Another company has completed some extensive investigation into meter accuracy under a mileage-change program, and reports no correlation between in-test proof and Mcf passed, so concludes that if meters are sized properly, and if the change period is the proper length of time, the mileage system offers no improvement in overall meter accuracy.

Slow light tests

Several companies find that various types of slow light tests indicate that an undesirable large percentage of their smaller meters are not able to measure the extremely small loads, such as pilot flames, etc. They feel that a mileage-change program would result in more unmeasured gas passing because these meters would probably be left in service between repairs for a longer period of time.

The effect of mileage (or wear) on new meters is an interesting study. Most of the companies surveyed find that the net effect is to make new meters measure slow, although there were exceptions to this opinion. In general, they felt that a mileage program would tend to make older meters in-test slow, but not as markedly as in the case of new meters. In other words, repaired meters do not show the effects of wear that new meters do. Probably the change in accuracy between new and repaired meters is not to any great extent caused by part wear, but is the result of diaphragms setting or wearing in.

Tinned steel-case meters seem to show better resistance to mileage than do iron or alloy meters. In most cases, this is related directly to the fact that tin meters make fewer revolutions per cubic foot of fluid measured.

The survey indicates that meters repaired on a periodic basis are passing highly varying amounts of gas between repairs. This is logical because customer demand varies and the periodic repair period varies widely between companies

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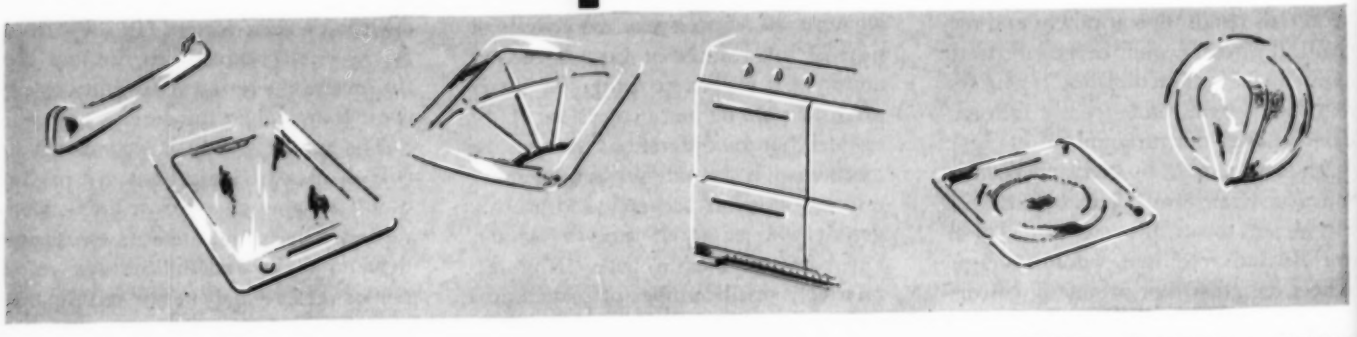
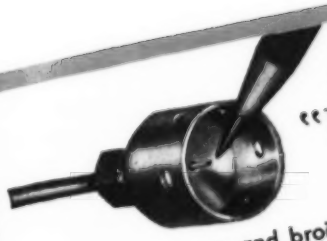


practical too...



amazing "Insta-Lite" ignition

Top burners, oven and broiler light instantly... automatically! "Insta-Lite" employs a tiny bead of flame... uses next to no fuel. Exterior range surfaces stay cool. Developed with A.G.A.

ASSURES FAST POSITIVE LIGHTING

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EFFECTS IMPORTANT FUEL SAVINGS

built-in "Glamor-Grill"

Polished, built-in griddle is easily removed for cleaning. Has five-speed heat indicator. Fats drain quickly into grease tray. Ideal for hamburgers and similar foods.

with "4-Way" griddle cover

IT'S A GRIDDLE COVER

IT'S EXTRA WORK SPACE

IT'S A GRIDDLE SPLASH-BACK

IT'S A COOKIE SHEET

here are just a few of the many new Roper features

super alltrol "Center-Simmer" top burners

NOW Roper top burners provide four predetermined most-used cooking heats... instantly yours... even without looking. A thousand and one "in-between" heats, too. Turn burner full on to giant rushing flame. Turn to "click"... it's a measured frying flame. Another "click"... an ideal simmer flame. "Click" again... a tiny "Keep-Warm" flame.

"Comfort-Level" broiling

Broiler is positioned up near the cooking top... easily accessible. It's extra-capacity, too... big enough for the largest broiling jobs. Drawers are mounted on ball-bearings.

unified "Insta-Set" control panel

Integrates four important controls. "Insta-Matic" Oven Guardian for automatic oven cooking... Precision Timer for exact timing of cooking periods ... "Timed" Convenience Outlet... and lamp switch.

- ROPER GAS RANGES in 22" to 60" models
- ROPER "arRANGEable" built-in gas cooking units
- ROPER "DRY-AIRE" automatic gas clothes dryers

WRITE FOR FRANCHISE INFORMATION

GEO. D. ROPER CORPORATION • ROCKFORD, ILLINOIS

Meter changeout . . . New mechanical and economic considerations are needed

even when the same size, type, and make of meter is considered. For domestic service meters, the volume of gas passed between repairs varies from 200 to 1200 Mcf. The periodic repair period for this class of meter varies from 5 to 20 years. In general, the tin meters have a longer time in service than the iron case. This reflects standard practices from nearly all companies, but the wide variance in periodic repair periods reflects different policy approaches. Some companies shoot for maximum accuracy and feel that the meters will be more accurate if they are removed and put in good condition more frequently, regardless of the conditions under which they operate and the method of determining when they are to be repaired. Other companies let their meters stay on the line for the maximum period they can expect the device to produce legally accurate measurement. Many companies have no control over the repair period as this is controlled by regulatory bodies they operate under.

The survey tried to determine what the mileage change figure for domestic meters might be if the companies decided to change to a mileage basis. It was realized, of course, that much research would be required before this figure could be established; however, this question was asked merely to get the thinking of some top level metermen on the subject. The average mileage estimate (for domestic sizes) was about 1.5 MMcf. Several men preferred to state it as revolutions of the tangent, and their estimates ranged from 12 to 20 MM revolutions. Another idea was that domestic meters should be changed out at 3 MMcf or 15 years, whichever came first.

Most of these answering the survey are of the opinion that the greater the flow rate—for the same mileage—the greater is the reduction of accuracy and the greater the wear on parts. Most agreed that the meters will run slow under greater load, and feel that this effect is more pronounced than that on part wear; however, several metermen evaluated the results just the opposite, that is, they feel greater flow will loosen the mechanism more and the end result will be that the meter will run fast when in-tested. Still others think that the flow rate has no measurable effect on either accuracy or part wear. Perhaps some were thinking in terms of even flow at relatively high rates—it is generally agreed that heavy flow occurring spasmodically will have a greater net effect on meter accuracy. Also, greater flow means greater differential across the meter or, as metermen sometimes prefer to state it, greater absorption through the meter. Greater absorption means that the meter will have to run faster and that there will be a resultant increase in valve friction and friction at the intersection of other moving parts. This would seem to increase wear to parts. It should be remembered that as the rate of flow increases, the differential increases in direct relationship to the square of the rate of flow; therefore, it seems realistic to assume that the pressure on the valves and friction increase similarly with flow rate. Wouldn't this mean part wear should increase with flow rate?

A large percentage of smaller meters are not able to measure extremely small loads, such as pilot flames. Several companies believe a mileage-change program would result in more unmeasured gas passing because these meters would remain in service between repairs for a longer period of time.

The present cost for record keeping under the age periodic repair program ranges between $0.012 and $0.12 per meter per year. It is estimated that more modern machine-type records could be kept for a minimum that would range between $.012 and $0.015 per meter per year. The general feeling prevails that record keeping, using present manual or semi-automatic systems, would be much more expensive under the mileage-change program, and most companies indicated that the expected savings from the reduction of the number of classes of repair and a more standardized flow of repair through shops, would not altogether offset the increased cost of record keeping. There is a divided opinion (with little optimism) as to the relative cost of meter record keeping with electronic machines, or other late developments in the accounting field, in view of the high first cost of such equipment and the requirement that a heavy, constant work load must be applied to make them pay out.

Most metermen questioned felt that more mechanization in meter shops might result from a mileage change-out program if experience proved that this system made fewer classes of repair necessary. Also, a greater standardization of flow through the shop might result, allowing the use of more materials handling equipment. But it was well stated that the use of mechanization to produce reduced expenses in a repair shop must be based on a minimum number of units flowing through the shop, per unit time, before expenditures for this equipment can be justified, so it is necessary to study the situation and predetermine that these minimum units will be available. This would apply to any change-out program.

The supervisors of meter maintenance programs recognize their obligation to provide accurate metering to their customers at the most economical cost. They feel that without mutual understanding of the problems, meter repair programs are doomed to remain static. New mechanical and economic considerations are needed to keep abreast of the growth of companies and the increasing costs of labor and hard materials. Some meters produce better results than others receiving the same maintenance, so there must be a matter of design involved; hence, manufacturers' laboratories should interest themselves in this subject and/or other subjects that relate design with optimum meter change-out programs. Perhaps this is where such investigations should start, for few distribution companies can afford to do much investigation along with the expenses of everyday operations.

There are several factors that become apparent when one sifts through the

survey. First, we are even more convinced that meters can stay in service on the consumers' grounds for appreciably longer periods than at present. This, coupled with improved design and repair methods, should reduce the cost of our product—gas. We believe that the reduction of operating costs is realistic and necessary in the face of higher basic prices at the wellhead, city gate station, etc. Regulatory agencies can be persuaded that modifications in meter change-out rules are desirable when there are enough factual evidence and data to support the change.

Second, we should be alert for complacency in meter maintenance. We are in a competitive business and the meter, as the company's representative, should be maintained competitively, but with improved accuracy. We cannot let down in our search for greater accuracy in spite of the commendable record of the past: we doubt if the average gas company-maintained meter is very highly accurate when compared with electronic devices and modern engineering measuring standards. Accurate for the invested cost, yes; but certainly there is room for improvement. Metermen seem to want to have meters as accurate as modern design and maintenance can make them as long as there is a relationship with sound economy. We know we cannot buy new meters, install new equipment, or change our repair process unless we can economically justify money involved with these moves.

Third, we think some major changes in present meter repair programs must come, but such changes require careful investigation for each suggestion or idea leads to many problems; the problems, in turn, lead to many questions. Can the answers to these questions pay off? We think so, but it takes the combined resources of meter maintenance men, supervisory personnel, and manufacturers pulling together for the common, logical answer, and the meter maintenance people should be out in front with positive thinking rather than negative attitudes.

Fourth, changes are necessary in meter design, as well as in standardization of models in relationship to capacity. There are too many meters of different capacities on our lines and in meter shops. We can blame ourselves in this matter, for the manufacturers lean over backwards to fit their lines of meters to our whimsical demands. A mileage change-out program would provide running records of any particular customer's load, and an engineering study of the load, in correlation with connected appliances, could produce the actual load factor. Further study of the load factors of many customers should indicate that patterns or classes are formed that will fall into relatively few size ratings. For instance, the domestic consumer who lives in an apartment or project where the space and water heating services are distributed from a central source has little need for a meter that will pass 150 cfh because his load is that produced by a gas range, and is seldom very large. The load factor for the single range must be taken into consideration; the cook will seldom, if ever, fire all the burners on the range at the same time.

From this editorial corner, it appears that the days when the housewife had a cake baking in the oven, a steak broiling in the broiler, and four other foods cooking on the top burners have long since passed. We use the top burners for 80 to 90% of our cooking. At that, it is very rare when more than two of them are in use. Perhaps 30 cfh (1000 Btu/cu ft, natural gas) is the average maximum load that is likely to originate from a large gas range.

Similarly, the average loads for small, single family homes and for other homes can be correlated with domestic load factors. Again, such studies will indicate that there is little need for a multiplicity of sizes for domestic meters. This would also apply to meters in other classifications. True, such studies require a lot of information gathering and record keeping, but these can be used in many ways if someone will apply the necessary impetus. For instance, any survey or investigation into connected loads at particular consumers' homes should be used as a tool for the sales department or could be shared with appliance dealers.

It is believed that two meter sizes would fit about 90% of any company's domestic consumers. The same two sizes would not be common to all companies, but each company could study the problem and select two sizes consistent with their geographical location and economic situation. Wouldn't such a program reduce the cost of metering?

Another factor, and one that makes new meters cost what they do, is the idea that nearly every company has to have its own specifications for meters of the same make, type, and size. In effect, a manufacturer has to tailor-make each shipment of the same meter in his line to meet these specs. You pay for this—you pay for receiving your specifications and you pay for the other fellow's particular requirements. We do not believe there is that much difference in the basic function of measuring gas.

Meter design has been given much consideration during the last few years. There will be few who will not admit that our present meters are costly partly because they are designed and built so that they can be disassembled, part by part, and compeltely rebuilt. Many industries have long ago discarded the idea that mechanisms must be designed so that every part can be replaced or repaired; most have accepted the idea of replacement of assemblies and disposal of malfunctioning assemblies. They do not work with components—they repair on the basis of unit substitution. Perhaps this would work in the case of gas meters. All of us have heard the pros and cons of the disposable or throwaway meters that are in the forefront of design considerations. Of course, when any meter requires repair that will not pay out, the meter is disposed of, but this idea of a meter that is encased so that none of its internal elements are accessible is interesting. Actually, with the advent of relatively clean natural gas, there is not too much point in being able to reach valves and diaphragms as long as adjustments can be made from the outside and so long as the meter is produced cheaply enough to allow condemnation when the simple adjustments (made externally) will not bring the meter into the range of accurate measurement.

Another approach to design is the meter with the case welded or made in one piece below the valve table. Some metermen still feel that repair and inspection of valves is important, but agree that repairs below the table are generally too expensive to pay out. This design will allow some economy in its construction.

Finally, we know that none of the ideas in this article are new. They are presented in the hope that they will help bring about the birth of new thoughts and ideas. There is no doubt in our mind but what some of the metermen who read *GAS* can contribute new methods of repair and new thoughts on design that will enable the metermen of the nation to make greater strides in lowering meter maintenance costs and producing more accurate measurement. ■

WASHINGTON

Legislation to negate Phillips decision has 50-50 chance

By **LARSTON FARRAR** • Washington, D. C.

There are very few pieces of legislation on which the smart boys here will make book, considering the fact that the Democratic-controlled Congress will hold a veto power of the Republican-controlled White House recommendations, and that the White House holds a final veto over Congressional actions. But one project that seems much better than a 50-50 bet is that legislation similar to the old Kerr Bill, vetoed four years ago by the then President Harry S. Truman, will be passed by the Congress and signed by the President.

This legislation, which, as gasmen well know, would negate the now-historic Supreme Court decision in the Phillips Petroleum case, seems virtually certain to pass before the summer sun causes any prostration in steamy Washington, which means before June 15, at the outside.

Ironic development

If this does happen—and it most likely *will*—it will represent an ironic development, from the standpoint of the members of the Federal Power Commission, who have suffered one headache after another since the Supreme Court's decision last year. It will be recalled that the FPC counsel itself was opposed to bringing natural gas producers and gatherers under federal control and argued against it before the high court. At that time, the FPC was on the defensive from the so-called "consumer groups" of Michigan, Wisconsin, etc., and from snipings of organized labor.

Then, after the decision, the FPC quickly found itself on the defense against the natural gas industry, in effect. Merely to get started on its unwanted task, the FPC issued Order 174. This provoked such outcries from the producers and gatherers that it then issued Order 174-A, extending twice the deadline for filing under the new jurisdictional arrangements.

Now, hearings are scheduled by FPC in mid-January to determine the rules to apply in regulating the producers. It already has issued some 100 certificates, more or less, to producers and gatherers, and is literally deluged under the paper work brought about by the subjecting of thousands of producers to FPC regulations.

At about the time the FPC is scheduled to sit down to listen to the arguments for and against certain procedures and operations under the new authority, Congress likely will be getting the first bills to withdraw the authority from the FPC. Just who will introduce the legislation—or how many, which might be a more pertinent point—was not known definitely at year-end. However, it seemed very possible that Democratic Leader Lyndon Johnson (D.-Texas), who is very upset over the Phillips decision, would introduce a bill in the Senate and any number of Congressmen are prospects in the House of Representatives.

Sen. Robert S. Kerr (D.-Okla.), who was author of the famous bill bearing his name and vetoed by President Truman, probably will *not* have his name on the new "Kerr bill," no matter how often it is called that in print. He has had his eyes on the Democratic nomination for President ever since the pre-convention maneuverings of 1952 and those close to him say that nothing has happened to make him feel that the mantle of national leadership yet may not be placed on his broad shoulders. Because his advisers feel that sponsorship of the legislation might cost him support—from labor and kindred circles—they say he is willing to let someone else carry the ball this year.

Ironically, the Federal Power Commission recently has reinstated its investigation of the rates of Phillips Petroleum Co. for natural gas sold in interstate commerce—which originally started the whole history-making case on the road to the historic decision.

The investigation first was started by FPC on Oct. 29, 1948, but the proceeding was terminated by the commission on Aug. 22, 1951, in an opinion in which a majority of the FPC found that it did not have jurisdiction over Phillips as a "natural gas company" under the Natural Gas Act. The FPC opinion subsequently was reversed, on appeal by various "consumer" groups, by the U. S. Court of Appeals for the District of Columbia Circuit, and, on June 7, 1954, the U. S. Supreme Court affirmed the lower court's opinion.

Reopens rate case

The commission's recent order reinstitutes the investigation to determine whether in connection with any transportation or sale of natural gas, subject to FPC jurisdiction, any of Phillips' rates "are unjust, unreasonable, unduly discriminatory, or preferential." If the commission so finds after hearing—date for which has not been set—it will determine and fix the "just and reasonable rates" to be charged by Phillips.

Adding irony to irony, several producing companies now have gone to court—and have won injunctions against complying with Order 174-A, at least for the time being. But the FPC went into court in one such case and actually persuaded the judge not to issue a restraining order against the commission. The commissioner's consistently have said that they do not want the power to regulate these companies, but that as long as they have the power, they must proceed in accordance with the law as interpreted by the Supreme Court. But if Congress acts soon—and that is the hope—it will relieve no producer of more headaches than it will be relieving FPC, which would like to go back to some of the relative quietness of its pre-Phillips days. ■

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MAKES YOUR COOKING OBEY EVEN WHEN YOU'RE AWAY

New thermostat-controlled fifth burner automatically maintains selected cooking temperature.

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The "Governess" holds temperatures *exactly* from 200° to 400° . . . automatically! A sensing element, in the center of the fifth burner, measures the temperature inside the cooking vessel. When the selected temperature is reached, the gas flame cuts down. Thereafter any variation in temperature, either up or down, is automatically corrected by the "Governess."

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A Completely New Unit

The *Governess* is a new application of heat control to open flame cookery. And it gives you the biggest gas range sales feature in 40 years. Field tested for the last two years, the Florence *Governess* has PROVED itself NO SERVICE PROBLEM. And, best of all, it's PRICED TO SELL! *Governess* models start as low as $269.95, retail.

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32 million selling messages . . . full pages in Better Homes & Gardens, Good Housekeeping, American Home, and Household . . . will bring women into *your* store to see this marvelous new way of cooking. Be ready to sell them any of the 19 beautiful models in the Florence line. From the 20-inch *Rangette* and the 30-inch *Spacesaver* to the magnificent 36 and 40-inch ranges, (*Governess* available on four models), Florence gives you the hottest line for '55, with the greatest selling feature.

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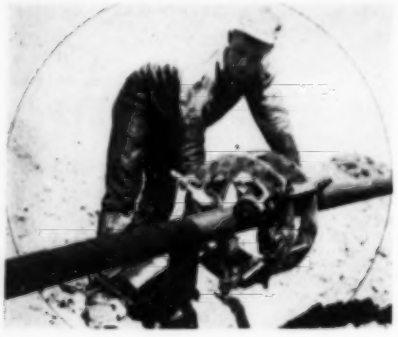


1 Pipe Wrapper

Dura-Tape is a new cold-application pipeline wrapper with a built-in primer. One application of the wrapper, produced by Dura-Tape Co., gives an electric insulator, a mechanical shield, and a chemical inhibitor.

Easy to apply by hand or machine, Dura-Tape can be used to wrap mains, service connections, and lines in utility systems. Holiday-free, the wrapper is also suitable for field welded joints on mill wrapped jobs. It can be applied under any weather conditions; two or three unskilled men can wrap from one-half to one mile of pipe per day. No special equipment is needed in the wrapping operation.

The primer itself is non-drying and Dura-Tape will stand 10,000 to 15,000 volts imposed by a holiday tester.

Dura-Tape Co.

2 Valve

Milwaukee Gas Specialty Co.'s Baso valve Type 829 has straight-through design, simplified manifold design and the rotor pilot valve, eliminating a separate "B" valve and extra pilot line fittings. In ⅜-in. pipe size, it has a capacity of 51,000 Btu per hour with manufactured gas. It is also available in ½-, ¼-, or ⅛-in. sizes. The hood and reset assemblies are replaceable in the field. The valve body is made of cast, heat-treated aluminum alloy and internal parts in contact with the gas are built of stainless steel and aluminum.

Milwaukee Gas Specialty Co.

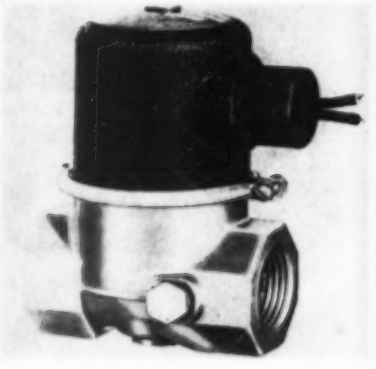
■

3 Magnetic Gas Valve

Elimination of valve closing impact noise and disturbing hum is featured in a newly developed General Controls Co. magnetic gas valve for gravity and forced air furnaces and unit heaters.

The new valve, called the K-3A, opens and closes gas lines at the demand of room thermostats, limit controls, and other devices. It is a soft-seated type with a specially designed solenoid to make it humless. The valve disc is made of synthetic rubber. It is brought into the shutoff position by spring action plus the steady pressure of gas. Available in sizes from ⅜-in. to ¾-in. ips.

General Controls Co.



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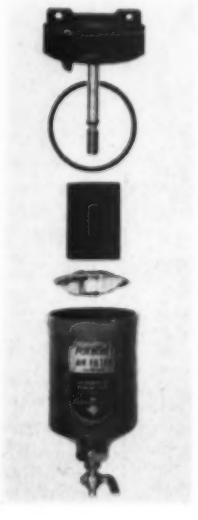
4 Air Filter



A compact air filter, designed to prevent foreign matter from entering pneumatic instruments, has been announced by Foxboro Co.

The new filter consists of a top cap with supply and outlet connections, a chamber with a drain cock at the bottom, a resin-impregnated filtering sleeve, and a water baffle. The unit can be mounted in a supported line or bolted to a wall or panel.

Filter capacity is 4 cfm of air or natural gas; sump capacity is 12 cu in.; filtering area, 21.2 sq in.; and maximum working pressure, 150 psi.

Foxboro Co.

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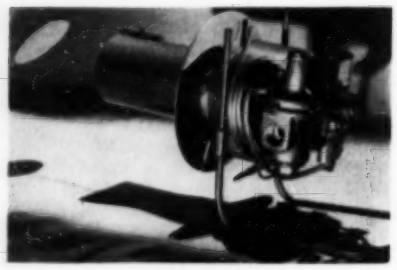


5 Monoport Burners

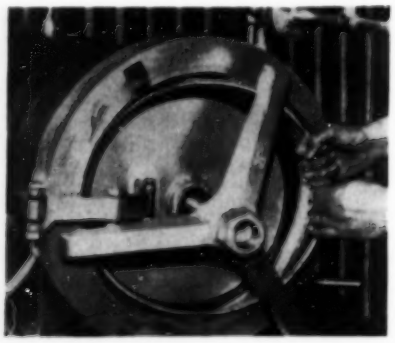
The new monoport gas burners, which are designed for conversion and original equipment, are available from Barber Gas Burner Co.

The SNG1-A (pictured), offered to heating contractors for conversion applications in residences, is rated on natural or mixed gas from 65,000 to 185,000 Btu input and on LPG from 75,000 to 105,000 Btu input. It is installed exactly like an oil burner and has no moving parts. Consisting of a pressed steel venturi enclosed in a blast tube, the burner is furnished with complete automatic controls.

Built along the same lines is the V line of Barber burners, which are offered to furnace and boiler manufacturers in ranges from 65,000 to 300,000 Btu input on natural or mixed gas, 65,000 to 250,000 on manufactured, and 65,000 to 150,000 on LPG. This line can be supplied with or without controls.

Barber Gas Burner Co.

■



6 Pressure Closure

A new type pressure closure for all types of pressure vessels and piping systems has been introduced by the Sillers Engineering Co. The Flex ring closure incorporates an internal pressure closing, metal-to-metal seal principle. It seals tighter as the pressure upon it increases.

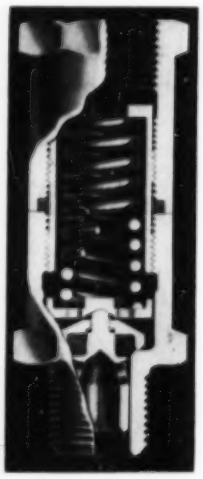
Sillers closures consist of four main parts: weld neck, plug, gasket and spider. The unique feature of the closure is the patented flexible metal gasket which is held in compression between the plug and weld neck. The gasket is flexed to an illiptical shape to allow it to pass through the plug opening. Once in place, tightening the spider nut causes the gasket to return to a round shape for proper seating position.

The closures are available in the same pressure ratings as ASA flanges and have the same pressure and temperature rating as corresponding ASA raised face flanges.

Sillers Engineering Co.

■

7 Relief Valve



Compact, lightweight construtions, made possible by the in-line design, contributes to the ease of mounting the new James-Pond-Clark circle seal 5100 relief valve.

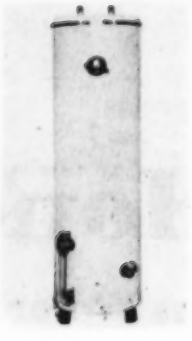
The performance curve shows a slight but regular increase in pressure drop with increasing flow rate. The use of an O-ring seal and a spring centering device, which allows only axial force to be transmitted to the poppet, results in sensitive operation and durability. No leakage is exhibited within as little as 2% of the present cracking pressure; the valve reseats with no leakage within as close as 5% of the setting.

It is available in either steel or brass for pressures from 50 psi to 1000 psi with male inlet and female outlet pipe threads.

James-Pond-Clark

■

8 Water Heater

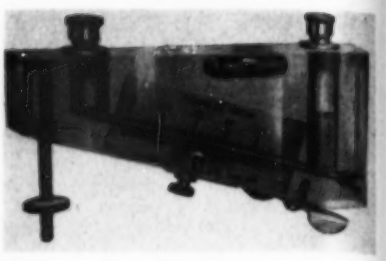


Malleable Iron Range Co. has introduced a new high efficiency, fast recovery gas hot water heater.

Special features of the Monarch heater are a Unitrol 100% safety shutoff, an extra heavy gauge storage tank, a high efficiency slotted cast iron burner and filter.

A special feature is the flue bafflex, which slows escaping gases, reduces stack loss and lowers operating costs by deflecting heat to the water. The AGA-approved water heaters are available in either 30- or 40-gal. capacity.

Malleable Iron Range Co.



9 Measuring Gauge

Designed to measure the static pressure drop across the evaporator of residential air conditioning systems, Dwyer Manufacturing Co.'s new gauge provides a tool-kit size instrument that is quickly attached or detached, is breakproof, and permanently accurate.

Designated No. 172, the gauge measures 0 to 1-in. water pressure on a 3-in. scale calibrated in .02-in. divisions. In operation, the gauge is attached and then the blower speed is adjusted until the pressure drop reading corresponds with the manufacturer's recommendation.

F. W. Dwyer Manufacturing Co.

■

10 Gas Range

Hardwick Stove Co.'s new 30-in. range features an oven that measures 24 in. across. Completely new, the range has a glass and chrome-trimmed Astra-Glo back panel, matching valve handles, and light, clean door handles. The valve control panel is recessed, as are the oven and broiler door handles.

The 30-in. range has two giant and two standard size top burners, Equa-Flo oven burner, and optional EconoMatic oven lighting and Super EconoMatic 100% safety shutoff.

Hardwick Stove Co.

■

11 Moisture Trap

A new V. D. Anderson Co. No. 81 float-type moisture trap has been designed as a low cost method of draining moisture and condensate continuously and automatically from piping systems,

...that cannot produce rust-discolored hot water, yet sells at prices comparable to lined-steel-tank types!

The sensational new RUUD ALCOA® ALLOY Automatic Gas Water Heater

Here's the kind of gas water heater you know you can promote profitably. A *solid aluminum alloy tank* that can't produce red-rust . . . in a quality unit priced competitively with ordinary lined-steel-tank water heaters.

Top quality—backed by the combined skills and resources of two top-rated names in their fields. RUUD . . . America's oldest manufacturer of quality water heaters, and ALCOA . . . world's largest producer of aluminum.

The new Ruud Alcoa Alloy is a fast-recovery unit that delivers more hot water faster, cleaner and longer than any other water heater, at or anywhere near its price. It safely stores water at 180° sanitizing temperature.

An optional convenience! Ruud duo-temp feature delivers two hot water temperatures from the same tank at the same time! 180° water to maintain a temperature of 160° in the automatic washer; 125° tap-safe water for bath, shower and lavatory.

® Aluminum Co. of America

ADVERTISED IN
The Saturday Evening
POST

Mail This Coupon Today!

The revenue-building Ruud Alcoa Alloy is Laundry-Rated to meet the critical hot water quantity and temperature demands of automatic clothes washers. Send for complete details today.

RUUD MANUFACTURING COMPANY
Dept. F-29, 2934 Smallman St., Pittsburgh 1, Pa.

☐ Please have a Ruud man call on me.

☐ Please mail further information on the new Ruud Alcoa Alloy Gas Water heater.

NAME _____ TITLE _____

BUSINESS NAME _____

STREET _____

CITY _____ ZONE _____ STATE _____

"You could do it better with a corkscrew, Charley . . ."

Yes, there are times when a corkscrew does it *better.* And one of those times, oddly enough, is when you're looking for an anode core that *won't separate* from the anode. That's why so many corrosion engineers prefer Standard Magnesium's VIBRA-PAK Anodes — the patented spiral core really stays put! There are other good reasons for this preference, also. The magnesium itself, for example, is spectrographically analyzed to assure *greater purity* — that means more current per pound of magnesium. And, of course, there's the best reason of all: VIBRA-PAK is the "ready-made" anode which comes to you already compacted and centered in backfill, ready to drop in the hole.

Standard Magnesium Corporation
TULSA, OKLAHOMA

Pioneers of: SPECTROGRAPHICALLY ANALYZED ANODES AND CYLINDRICAL ANODES

CLIP THIS AND MAIL TODAY
if you have not subscribed to . . . GAS

GAS 198 SOUTH ALVARADO STREET, LOS ANGELES 57, CALIFORNIA
Standard Rates Apply to U. S. & Possessions

☐ Check herewith ☐ Bill me ☐ 2 years $3.00 ☐ 1 year $2.00

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____

Hi-eF purifiers and other equipment handling air, gas or steam. The moisture trap is suitable for operating pressures up to 200 psig and has an optional inlet for ease of installation.

The trap consists of a stainless steel valve and seat and lever, plus a copper hide float inside a cast semi-steel case.

V. D. Anderson Co.

■

12 Threading Kit

Beaver Pipe Tools Inc. is now marketing a compact pipe- and bolt-threading kit for use by plumbers, pipe fitters, electricians and others. It provides storage space in the steel kit box for the threader and all basic dies.

The kit includes the Beaver No. 71 hand threader; a set of ⅛- to ¾-in. pipe dies; a set of ¼- to 1-in. bolt dies; and the Beaver No. 71-R ratchet.

Beaver Pipe Tools Inc.

■

13 Welders

A new line of Airco welders, NEMA rated 300, 400, and 500 amp models, feature stepless current control, silicone insulation, aluminum coil windings, and are equipped with a large current scale. Fingertip current adjustment and quieter operation are made possible by a new feature in which the coil supports float in a special rubber bushing.

Air Reduction Pacific Co.

NEW! beauty sales appeal ease of service

because it's easy to get at!

NEW! Robertshaw-Grayson UNITROL® 200

FOR AUTOMATIC GAS WATER HEATERS

HELPS YOU SELL WITH ALL THESE "LEAD THE FIELD" FEATURES:

Snap-on temperature dial can be exposed while body of control can be located inside heater shell.

For exposed or concealed application.

Precision-cast body with snap-on aluminum cover available in wide choice of colors.

Colored plastic temperature dial with bright metallic center disc for heater brand name.

Combines snap action thermostat, thermo-magnetic automatic pilot, large capacity gas cock and high capacity filter.

"100% shut off" type with safe lighting feature.

Mr. Controls®

Robertshaw-Fulton CONTROLS COMPANY

Grayson Controls Division, Long Beach, California

Robertshaw-Fulton Controls (Canada) Ltd., Toronto

GAS trade literature

14 Plastic Bulletin

Properties of porous Kel-F plastic, and design and performance data on complete filters equipped with this new filter media are presented in a bulletin from Porous Plastic Filter Co. Several basic types of newly developed filters, data on pore size, particle size removal and flow capacity, in addition to information on the company's engineering and application services, are presented.
Porous Plastic Filter Co.

15 Plug Valve Catalog

ACF lubricated plug valves have been described in a new catalog from ACF Industries Inc. Twenty-two of the principal services, including gasoline, oil, water, air, gas, acids, caustic solutions, chemicals and other fluids, are mentioned.
ACF Industries Inc.

■

16 Carbon Control Bulletin

The Autocarb system for automatic carbon control of heat treat furnace atmospheres is the subject of a new technical bulletin issued by Surface Combustion Corp. Discussed are means by which the carbon potential of the furnace atmosphere may be controlled at the desired level for many processes.
Surface Combustion Corp.

■

17 Heater Bulletin

"Kemp Case Histories" is a 20-page bulletin issued by C. M. Kemp Manufacturing Co. presented in a detailed report, with on-the-spot photographs, of installations of Kemp immersion heaters, dynamic dryers, and inert gas generators.
C. M. Kemp Manufacturing Co.

■

18 Receiver Recorder

A receiver-recorder for pneumatic and electric transmission systems is described in detail in Bailey Meter Co.'s Product Specification E12-5. The 12-page brochure includes illustrations, applications, operation, engineering and ordering specifications.
Bailey Meter Co.

■

19 Communication Booklet

Specific suggestions on where to look for "concealed" problems in business operation and management are contained in a booklet just published by Automatic Electric Sales Corp. The booklet analyzes the problems of intra-office telephone communications.
Automatic Electric Sales Corp.

■

20 Gate Valve Catalog

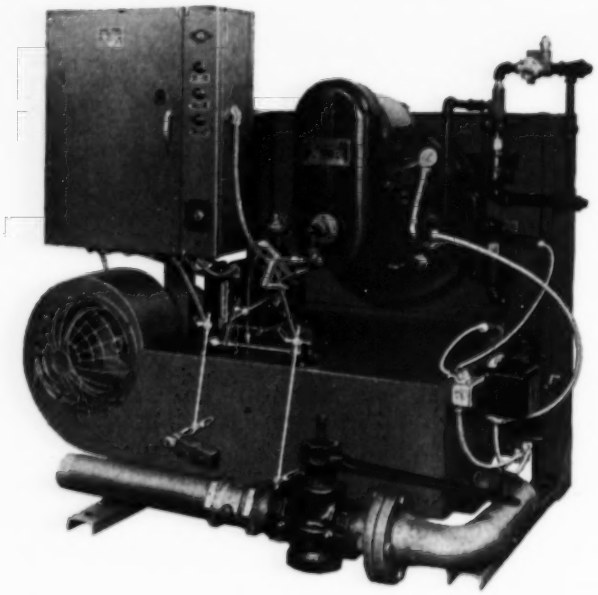
Major stainless steel gate valves in the Cooper Alloy Foundry Co. line are described in a new catalog (No. 55G). In addition to schematic drawings, the booklet includes a section on design factors and a discussion of construction materials, standards, and quality control measures.
Cooper Alloy Foundry Co.

■

21 Controller Catalog

Stack-type pneumatic controllers for process variables are illustrated with cutaway construction photos, schematic diagrams, and dimension drawings in Fischer & Porter Catalog 53-10. The 12-page catalog contains specifications, controller response actions, and a controller selection guide.
Fischer & Porter Co.

WEBSTER ROTONETIC*



DUAL FUEL FIRING BURNER

- Sizes from 75 to 300 horsepower.
- Minimum gas pressure requirements.
- Low installation costs.
- Maximum efficiencies on BOTH gas and oil.
- Minimum base height requirements.
- Utilizes all grades of fuel oil.
- Extremely low noise level.
- Approved electronic combustion safeguard system.
- Simpler changeover than ever before.
- One hundred per cent forced draft.
- Completely assembled, piped, wired and tested.

These and many other outstanding features combine to provide the same dependable high quality performance as the WEBSTER DYNETIC gas burner. Neither fuel must suffer if the WEBSTER ROTONETIC is used. With integral pumps, integral oil preheaters for heavy oils, patented oil burner "flame-shaping" vanes, and full modulating or optional high-low control, the WEBSTER ROTONETIC is designed to provide long lasting customer satisfaction the year around.

It is furnished with a precast refractory front as an integral part of the burner assembly. The installer need only finish the furnace wall on each side and above the burner.

WRITE FOR LITERATURE
Listed by Underwriters' Laboratories, Inc.

*Trademark

The WEBSTER ENGINEERING COMPANY
TULSA, OKLAHOMA
Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

Presenting **the New**

CRISE

Solenoid Gas Valve

Higher Capacity

The Crise Solenoid Gas Valve has been designed to combine performance, ruggedness and simplicity for long, trouble-free service on all types of gas fired heating equipment. A soft seat is accurately centered by an improved design to assure positive shut-off and quiet operation. Corrosion-resistant parts make the Crise SV-100 and SV-110 suitable for use with all types of gases. Available in ½" and ¾" sizes, 24 V or 115 V and with or without a manual opener. Write for bulletin.

Visit our booth at the 12th International Heating and Ventilating Exposition

A Host of Features

- High Capacity
- Soft Seat Construction
- Quiet Operation
- Streamlined Design
- Positive Shut-off
- Corrosion Resistant
- Suitable For All Gases

CRISE CONTROLS DIVISION

ACRO MANUFACTURING COMPANY

COLUMBUS 16, OHIO

Distributed in Canada by Leland Electric Canada, Ltd., Guelph, Ontario

GAS news

Bureau of Census will query mineral industries

Early in 1955 the Bureau of the Census will conduct censuses of business, manufacturers and mineral industries.

The census of mineral industries provides for an enumeration of approximately 35,000 mines, quarries, and oil and gas establishments. It will collect data, for the first time since 1939, on the number, size, location and character of operations in the mineral industries, as well as data on number of workers, value of products, principal expenses, expenditures for plant and equipment, quantity of fuels and electric energy consumed, and horsepower of equipment installed.

This census will be a mail canvass and will be co-ordinated closely with the Bureau of Mines statistical program and joint schedules will be used insofar as feasible to reduce the reporting burden of the respondents.

Action program put to work in New Jersey area

Reports of solid sales results, new employee enthusiasm, and close coordination of dealers, manufacturers and utilities were made by representatives of the action demonstration program companies participating in the Gas Industry Development program at a recent meeting in Ocean City, N. J.

One report was from the New Jersey Natural Gas Co., which put the program into effect in Cape May county, used as a test area instead of a single city. It is a vacation area with a fluctuating population of from 100,000 families in the summer to 13,600 permanent residents. Approximately 58% of all consumers are gas customers.

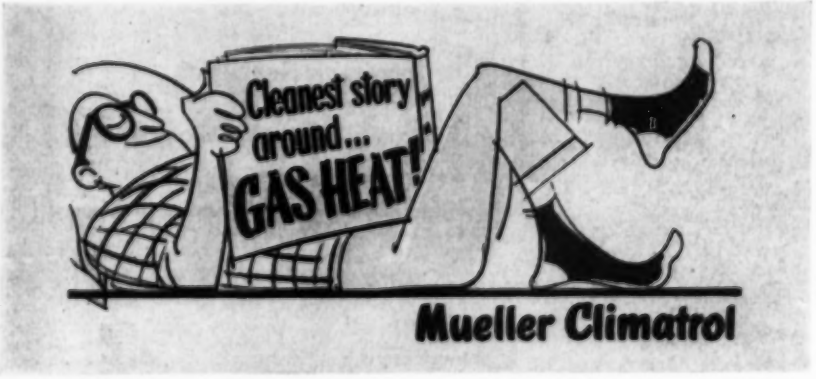
A market analysis of the area showed that among the permanent residents about 51% cooked with gas and 44% with electricity. Electric water heaters outnumber gas 32% to 24% and oil househeating was ahead 75% to 14%. About 4% used gas refrigerators. Other gas appliances were so negligible as to be unmeasurable. The survey indicated a strong consumer demand for electric appliances has developed in the past five or six years and it was decided that a strong demonstration job was needed, in addition to increased sales promotion and merchandising with the established sales groups already working in that area.

Among steps taken to develop the market was the establishment of a stronger program of sales training and product knowledge for the residential salesmen covering the area. To obtain more complete coverage, three women were trained in telephone sales technique. They found more than 60 sales prospects in three months. A full-time man was assigned to call on dealers.

A new home service advisor was employed to initiate a complete home service activity in the area. In addition, a series of individual promotional programs was developed, high quality gas ranges were actively promoted for the first time, and a campaign for gas heaters was initiated with a single manufacturer selected to test a particular promotional idea. Results of the heater program were extremely good. Overall space heater sales for that area were much higher than for other areas in the company territory.

Other phases of the program include cooking schools for four-day duration.

Initial results of the demonstration activities in the Cape May area have been most encouraging. Enthusiasm of employees reflects greater interest on their part in better customer service and increased job interest. The attitude of local consumers and dealers favorably measures the increase in gas business that can be attained throughout the nation with this kind of gas industry action.



Outdoor posters were used by New Jersey Natural in Cape May county as part of its action demonstration program in the area.

Missouri PSC overrules storage objections

The Missouri Public Service Commission has overruled motions for a rehearing of Laclede Gas Co.'s application for approval of its plans to create underground gas storage facilities in north St. Louis county. The commission approved the plan in November.

Several opponents of the proposal had asked a rehearing, claiming that establishment of underground storage areas would endanger lives and property of residents of the area. They are expected to seek court review of the PSC findings.

Rheem to market built-in automatic clothes dryer

Deliveries will begin this month on a new built-in automatic gas clothes dryer that is being placed on the market by Rheem Manufacturing Co.

Said to dry laundry in 45 minutes, the dryer is reportedly the first that can be built into the kitchen wall or laundry section of the house. It can fit under a hot water heater or cabinet. Rheem anticipates its largest market will be among builders of new homes who will be able to buy the units in quantity for tract developments. However, the dryer can also be installed in existing homes.

Utility stock prices reflect general optimism

Natural gas company utility stock prices, continuing to reflect the general optimism prevailing in the securities market, were 17.7% greater on November 26, 1954 than one year earlier, and only 0.8% lower than the peak occurring in the 1953-1954 period. Coupled with this increase in price, dividend payments advanced 6.1%, resulting in a relative decline of 9.9% for yields on those stocks when current periods are compared to that of a year ago.

The price of the 10 gas transmission company stocks increased 16.5% over the comparable period of last year, while the price of the 10 gas distribution utility stocks increased 17.5%. Accompanying these price changes were increased dividend payments of 7.1% and

TWO GREAT NAMES...

THE MAYFLOWER

WASHINGTON, D. C.

Equipped with **GARLAND...**

THE GREATEST NAME IN COMMERCIAL COOKING!

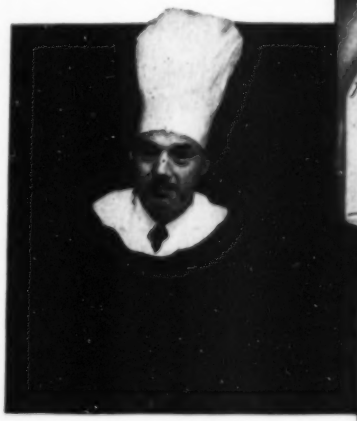
All over the World—
Garland means Finest!

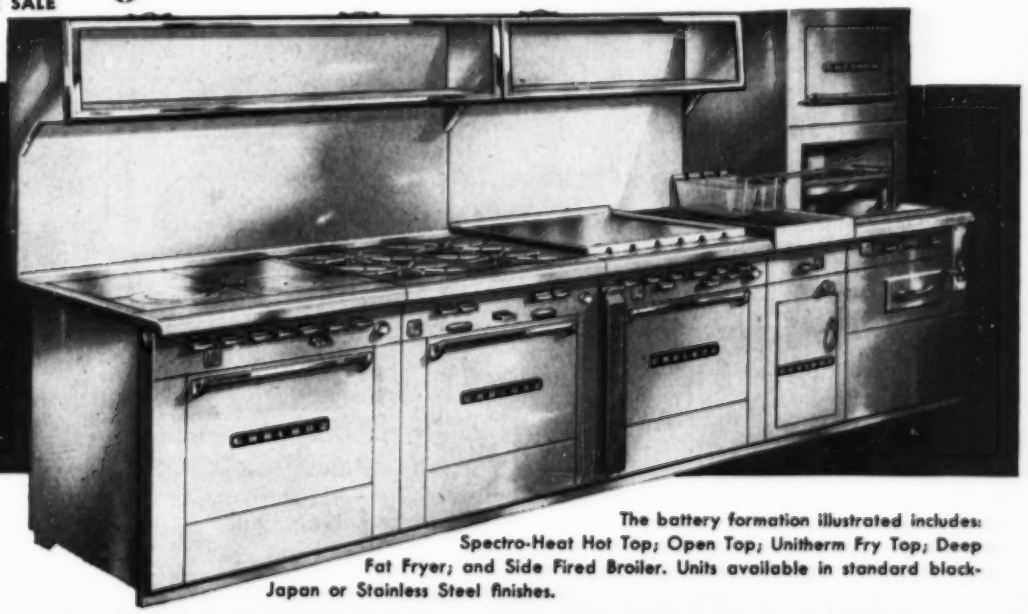
Internationally famous chefs team with Garland to maintain their well-earned reputations. Where cuisine is renowned —Garland is used to prepare it!

Whether the operation is large or small, chefs instinctively turn to Garland. There are reasons for such a vote of confidence! Garland has years ahead design—it's fast—it's flexible—it's durable! It's performance earns its title—Garland—the Line of the Leader!

EVERY SALE A DEALER SALE

Fired by Gas, the "Ideal Fuel" • Supplied by Washington Gas Light Company





The battery formation illustrated includes: Spectro-Heat Hot Top; Open Top; Unitherm Fry Top; Deep Fat Fryer; and Side Fired Broiler. Units available in standard black-Japan or Stainless Steel finishes.

Look for the 45-29 Club pin . . . it's the mark of an expert!

DM PRODUCTS

Heavy Duty Ranges • Restaurant Ranges • Broiler-Roasters • Deep Fat Fryers
Broiler-Griddles • Roasting Ovens • Griddles • Counter Griddles • Dinette Ranges

PRODUCTS OF DETROIT-MICHIGAN STOVE CO., DETROIT 31, MICHIGAN
IN CANADA: GARLAND-BLODGETT LTD.—1272 Castlefield Ave., Toronto

WE FOUND IT!
IT IS DOWN IN TEXAS!

The Best Insulated Pipe Union in the World (Texas Too!)

• Sizes — 1/2" thru 4" inclusive • Pressure Rating —300 #W.O.G. • Insulate Domestic meter loops • Insulate well flowlines • Economical in price • Available from stock

All Threads Metal to Metal — No Plastic Threads To Strip Out

WHY WAIT TO INSULATE 'TIL '58?
WHY NOT DO MORE IN '54?

SERVICE ENGINEERS, INC.
Manufacturers of Industrial Plastic Products
3030 W. Pafford P. O. Box 11068 Fort Worth 9, Texas

1897 1954

PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER COMPANY

GOODMAN
USED SINCE 1897
2" HANDLE & LOCKING SLEEVE
GAS MAIN STOPPER

523 Atlantic Avenue
Brooklyn 17, N. Y.
Cable Address GASTOPPER, N. Y.

5.2% for the transmission and distribution components of the index. Because of the larger relative increase in prices than in dividend payments for these common stocks, yields declined 8.0 and 10.5% for transmission and distribution companies, respectively.

Management Workshop will feature human relations

"Human relations" will be the theme of the 1955 Columbia university Utility Management Workshop, executive development and training conference held annually by the Department of Industrial and Management Engineering, at Arden House, Harriman, N. Y.

Approximately 40 specially selected top-management executives will live together and work together to solve problems posed by the university staff and a corps of visiting experts. The industry participants work in small task force groups applying their own experience and knowledge to the problems set forth.

The workshop is under the direction of Prof. Robert Teviot Livingston, author of "The Engineering of Organization and Management" and director of education and commercial research of the Long Island Lighting Co. Participation in the workshop is open to nominees from private utility, airline, railroad and transportation companies.

Louisiana Power & Light forms new subsidiary

Louisiana Power & Light Co., New Orleans, has formed a subsidiary company, Louisiana Gas Service Corp., and with the necessary regulatory approvals will transfer to this new company all of its gas and water properties.

The move is in compliance with an order of the SEC calling for the utility to dispose of its non-electric properties.

The new organization will be staffed from existing personnel of LP&L. Officers of the new company are W. O. Turner, president; G. C. Rawls, vice president; A. E. Elliott, secretary and treasurer. A. B. Paterson is scheduled to become vice president in charge of operations; J. C. Puckett, assistant secretary and assistant treasurer, and A. W. Durning, chief engineer.

Architect-builder setup organized by Lone Star

Lone Star Gas Co., Dallas, has introduced into the field of gas appliance selling a new sales scoring sequence—a highly trained team operating within the framework of a newly established

ALABAMA:
Steel City Supply Co., Birmingham
Steel City Supply Co., Montgomery

CALIFORNIA:
Sierra Pipe & Supply Co., Bakersfield
Federal Pipe & Supply Co., Fresno
Fresno Distributing Co., Fresno
Yosemite Suppliers, Merced
San Diego Pipe & Supply Co., San Diego
Edwards Plbg. Supply Co., San Francisco
Federal Pipe & Supply Co., San Francisco
Richmond Pipe & Supply, San Pablo
Bessone Plbg. Supply Co., Santa Rosa
Familian Pipe & Supply, Southgate
Delta Pipe & Supply Co., Stockton

COLORADO:
B. K. Sweeney Co., Denver

DELAWARE:
Wilco Plbg. & Htg. Supply Co., Wilmington

DISTRICT OF COLUMBIA
Edgar Morris Sales Co., Washington, D.C.

FLORIDA:
Pearce & Johnson, Inc., Jacksonville

GEORGIA:
Rumbold & Co., Atlanta

ILLINOIS:
Barney Olson, Inc., Chicago

INDIANA:
Budlock Refgr. Supply Co., Inc., Evansville
Baker Specialty & Supply Co., Logansport

IOWA:
Globe Machinery & Supply Co., Des Moines
White Refrigeration Supply Co., Des Moines
Waterloo Heating Supply Co., Waterloo

KANSAS:
Union Appliances, Independence

KENTUCKY:
Zipper Gas Heating Service, Inc., Louisville
Brandenburg & Gibson, Pineville

MISSOURI:
Riback Pipe & Steel Co., Columbia
Twin States Heating Supply Co., Kansas City
White & Hazleton, Kansas City
The Moore Co., Sikeston
General Wesco Distributing Co., Springfield

NEBRASKA:
General Engineering, Inc., Omaha

NEVADA:
Osborne & Dermody, Reno

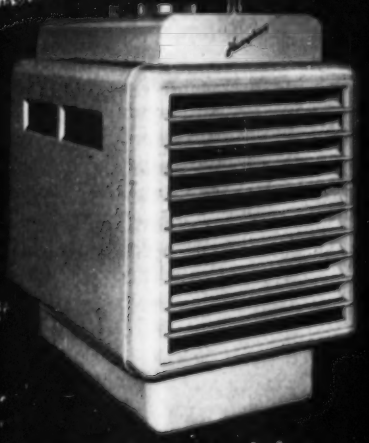
NEW JERSEY:
Hudson Gas Appliances, Englewood
New Jersey Gas Heating Specialties, Paterson
Warren Balderston Co., Trenton

NEW YORK:
Allen Heating Supply Co., Buffalo
Gas Equipment Corp., Long Island City
Fueland Corp., Liberty
Fallsburg Gas Service, Inc., South Fallsburg

NORTH CAROLINA:
Shaw Distributing Co., Charlotte
Carswell Distributing Co., Inc., Winston-Salem

OHIO:
The Hardware & Supply Co., Akron
W. H. Kiefaber Co., Chillicothe
F. J. Scull, Cincinnati
Columbus Gas Specialty Service, Columbus
W. H. Kiefaber Co., Dayton
W. H. Kiefaber Co., Hamilton
Automatic Heating & Engineering Co., Lima
The Hardware & Supply Co., Massillon
Heating Trades Supplies, Toledo

94 Authorized Humphrey Distributors now making immediate deliveries ON THE WORLD'S FINEST GAS UNIT HEATER



Humphrey Model A

Humphrey
Model 40-G

PENNSYLVANIA:
General Gas Services, Inc., Chambersburg
Tomlinson Co., Inc., Chester
George Neidermyer Co., McKeesport
Smith Furnace Co., New Castle
Chelton Plbg. Supply House, Philadelphia
Edward R. Sabin Co., Philadelphia
I. M. Clompus, Phoenixville
Charles E. Abersold, Pittsburgh
American Hardware & Supply, Pittsburgh
Gas Appliance Service Co., Pittsburgh
Keps Electric Co., Pittsburgh
I. M. Clompus, West Chester

TENNESSEE:
Farnsworth Heating & Supply, Bristol
Hughes Heating Supply Co., Memphis
Dale Supply Co., Nashville
K-T Distributing Co., Union City

TEXAS:
Clowe & Cowan, Amarillo
Austin Plbg. Supply, Austin
Southland Supply Co., Dallas

UTAH:
The Salt Lake Hardware Co., Salt Lake City

WEST VIRGINIA:
Gresham Plbg. Heating Supply, Charleston
W. M. Johnson, Huntington
Karr Supply Co., Wheeling

WISCONSIN:
McKinley Sales, Inc., Appleton
Monroe Engineering Corp., Butler (Milwaukee)

CANADA:
SuperWay Products, Ltd., Tilbury, Ontario

LOUISIANA:
Levingston Supply Co., Baton Rouge
Coburn Supply Co., Lafayette
Levingston Supply Co., Lafayette
W. J. Riley Supply Co., Monroe
Crane Co., New Orleans
R. F. Zimmerman & Co., Shreveport

MARYLAND:
Kleinman Bros., Inc., Baltimore

MASSACHUSETTS:
Cole & Sampson, Boston

MICHIGAN:
Galloup Pipe & Supply Co., Battle Creek
Warren Plbg. Supply Co., Detroit
Bennett Heating Equip. Co., Grand Rapids
Campbell Distrib. Corp., Livonia
Bell Engr. & Supply Co., Three Rivers

MINNESOTA:
Roberts-Hamilton Co., Minneapolis
Waterbury Heating Supply Co., Minneapolis

MISSISSIPPI:
A-T-M Gas Equipment Co., Jackson

That's right! All of the fine concerns listed here are Authorized Distributors who stock Humphrey Gas Unit Heaters for quick delivery. The list of Humphrey Distributors is still growing, too. We want to make it possible for you to get immediate shipment of these fine Gas Unit Heaters from a nearby warehouse stock, regardless of where you may be located, because we believe that better service on better unit heaters means better sales and profits for you.

FACTORY WAREHOUSES

GEN. GAS LIGHT CO.
23 Warren Street
New York, N. Y.

GEN. GAS LIGHT CO.
225 11th Street
San Francisco, Calif.

GEN. GAS LIGHT CO.
Mid-West Terminal
2020 — 2030 Walnut St.
Kansas City, Mo.

GEN. GAS LIGHT CO.
Central Forwarding Warehouse
1412 Jeffries Street
Dallas, Texas

GENERAL GAS LIGHT CO., KALAMAZOO, MICHIGAN

architect-builder department.

The new department is promoting the company's business through the more than 3000 architects, architectural designers, building supply firms, kitchen cabinet dealers, and builders operating in the 427 cities, towns and communities served by Lone Star.

Activities of the architect-builder program are coordinated, on a system-wide basis, by R. L. Stephenson of Dallas. Division supervisors, who report to the respective division sales and promotion managers, direct the program in their divisions.

James F. Oates Jr. (center), chairman of Peoples Gas Light & Coke Co., appeared on a recent telecast of "This Is the Midwest" in Chicago. He told the story of the Midwest's gas industry on the show via interview, films that he narrated, and models. Flanking him are Fahey Flynn (left), narrator, and Thomas H. Coulter of the Chicago Association of Commerce and Industry.

These activities are supplementary to and not in any manner a substitute for the company's standard sales promotion program. Formation of the department is designed to enable the company to maintain a year-round active program in the new construction field without diverting effort from other promotional activities.

In addition to the execution of actual sales, the architect-builder specialist will perform these functions: Assist the architect or builder in the planning and promotion of model or demonstration homes; sell the idea of adequate gas piping and appliance flue vents; act as contact man between all departments of the company and the architect-builder; and be on the alert for ideas and activities that will promote the company's business.

ARCCO
ARCCO CANNON NEVER-DRY PEN
Writes for Months
REPLACES OTHER MAKES • USES REGULAR INKS
Regardless of pulsations or other causes of ink failures this new Never-Dry Pen will make clean and complete records. Ink supply lasts for several months without refilling reservoir. Capillary tube from ink bottle placed in instrument case feeds pen with continuous flow. Closed system sealed from atmosphere prevents clogging and dirt accumulation.
Weight of pen is constant at all times thus insuring extreme accuracy. No slopping or dripping. Stainless steel construction—no corrosion. When ordering, specify make and type of recording instrument.
AMERICAN
RECORDING CHART CO.
3113 E. 11th St. • Los Angeles 23, Calif.
$6.00 each Net
Send for quantity prices
SEND FOR BULLETIN No. 115

Affiliated Gas will be merged with Carrier

Directors of Affiliated Gas Equipment Inc., Cleveland, and the Carrier Corp., Syracuse, N. Y., have approved the merger of the two companies. Consolidation is subject to legal requirements, including ratification by stockholders.

Present plans are that the two main operating divisions of AGE—Bryant and West Coast—would become operating divisions of Carrier. Cloud Wampler, president and chairman of Carrier, said the merger "will allow the combined companies to provide a complete line of both air conditioning and heating equipment, with special em-

phasis on the increasingly important home field."

Lyle C. Harvey, president and general manager of Affiliated, will become senior vice president and a director of Carrier upon completion of the merger. William A. McAfee and Francis H. Beam, now on the board of AGE, will also become Carrier directors.

Mr. Wampler's announcement added that the move makes possible Carrier's immediate expansion into new fields (home heating) with first-rate plant facilities and the established trade names of Bryant, Day & Night and Payne.

Baltimore's commercial use tax may be removed

The Baltimore (Maryland) county commissioners have asserted that they would eliminate entirely the special tax on the commercial use of gas in 1955 if the budget can be balanced without this source of revenue. Previously it had been proposed to increase the special tax by 2%.

Consolidated Gas Electric Light & Power Co., which will pay the county approximately $1,175,000 in taxes this year, takes the position that the special tax on gas and electricity is "excessive, improper, and discriminatory."

Special taxes, it was declared, tend to be self-defeating as they not only choke off the additional tax revenues which would come from industrial expansion, but encourage the users of fuels that are taxed to switch to those that are not.

Merger planned by Penn and Burgess-Manning

Directors of Penn Industrial Instrument Corp., manufacturers of electric and electronic flow meters as well as temperature and pressure control instruments, and Burgess-Manning Co., Libertyville, Ill., have approved a plan whereby Penn will be merged into Burgess-Manning.

If the merger plan is put into effect, Penn will continue operating with its present management as a separate division of Burgess-Manning.

Burgess-Manning, designers and manufacturers of industrial noise-abating equipment, has also announced that it has moved into a new but related field—construction of semi-portable audiometer rooms for testing the hearing of industrial workers.

The Acousti-Rooms are specially constructed and lined with acoustical materials that resist and absorb outside noise to create a practically soundless interior where tests of hearing may be recorded without interference.

Why
do most users
prefer and buy the genuine
RIDGID
PIPE WRENCH?

It's easiest to work with... perfect balance . . . comfort-grip I-beam handle . . . handy pipe scale on hookjaw . . . easy-spinning adjusting nut . . . clean grip on pipe, no slip or lock.

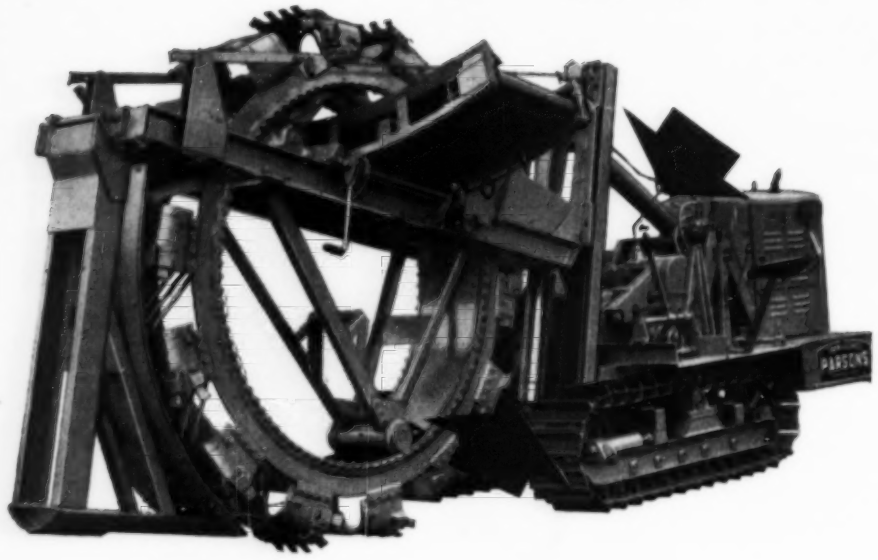
It lasts longer... first guaranteed housing, won't break or bind . . . ever. Every wrench individually tested before shipment . . . and millions of them in use. Sizes 6" to 60"—end pattern, 6" to 36".

For the most for your money, buy RIDGID . . . Your local Supply House stocks them for you, delivers them fast!

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID
Work-Saver Pipe Tools

hydraulic power raises, lowers, *tilts* the digging wheel



It's the NEW Parsons 150 Trenchliner!

Hydraulic wheel-hoist gives smooth, positive control of digging depth on the new Parsons 150 Trenchliner. A hydraulic ram on vertical mast raises and lowers the digging wheel, makes it easy to maintain accurate grade tolerance at any depth. A separate hydraulic ram tilts the mast — balances the weight of the wheel forward on the machine when traveling, loading or unloading on truck or trailer.

Simple mast design on the new 150 Trenchliner eliminates unnecessary superstructure, gives low overhead clearance for work and travel.

30 digging feeds from 12 inches to 25 lineal feet per minute sets a fast pace on pipeline, drainage, irrigation and utility trenching. (Tile box and chute optional.)

6 trench widths range from 16 to 26 inches wide. Maximum digging depth is 5¾ feet.

Quick-change buckets, solid-type or tine-back, are available with gumbo lips or self-sharpening, reversible "Tap-In" teeth for digging dry or wet materials. Buckets are all cast-steel.

Dual-purpose friction clutch drives the digging wheel and serves as an automatic safety to protect machinery against shock loads.

Shiftable, reversible belt conveyor, 24 inches wide, discharges spoil to either side. There are 3 speed selections on the conveyor.

Standard tractor crawlers have 16-inch treads, lug-type shoes or 12-inch treads with flat shoes. Only 6 or 8 lbs. PSI bearing pressure, depending on tread width.

Gas or diesel power — you have a choice of 58 h.p. gas engine, or 58 h.p. diesel.

All main gears enclosed in oil, all main shafts mounted on antifriction bearings assure dependable performance with Parsons 150 Trenchliner.®

Want more facts?

GAS news notes

The National Council for LP-Gas Promotion has adopted a resolution urging Congress to enact legislation amending the Natural Gas Act. The council fears that federal regulation of the natural gas industry, resulting from the Phillips decision, would curtail the supply of LPG and seriously cripple the L. P. gas industry.

An emergency bill providing that gas water heaters must have outlets to carry fumes outdoors has been presented to Mayor Robert F. Wagner of New York City. A public hearing was scheduled to be held on a related bill that would require that all gas appliances be serviced and inspected by utility companies, at the request of consumers.

Affiliated Gas Equipment Inc., Cleveland, reportedly will close the Cleveland branch of Bryant Heater division in the near future. With the completion of defense contracts, the company is now planning to consolidate its operations for more economical mannufacturing and distribution. Manufacture of water heaters and furnaces will be moved to five other plants of the firm.

The assets and business of the Globe Steel Tube Co., Milwaukee, have been purchased by Babcock & Wilcox Co. B&W will continue to operate the Milwaukee plant as a part of its Tubular Products division.

Ledeen Manufacturing Co., Los Angeles, has appointed Unisco Inc., New York, as distributors for southeastern New York, including New York City and Long Island, and northeastern Pennsylvania.

Most of Servel's civilian manufacturing operations will be closed this month to permit adjustment of inventories and to prepare for the manufacture of 1955 products. Production will be resumed early in February.

Caloric Stove Corp., Topton, Pa., has changed its corporate title to Caloric Appliance Corp. The change in name coincides with company growth and modernization as well as with expansion of its product line.

Selas Corp. of America, Philadelphia, has acquired the physical assets of Southwest Steel Plate Division, Houston, manufacturer of pressure vessels and mobile compressors. The new unit will be known as Selas Constructors Inc. It will be under the management of R. T. Clare Jr.

GAS people

Promotions

W. M. Jacobs

F. M. Foster
Southern California

W. M. JACOBS has been named vice president and assistant general manager of Southern California Gas Co., Los Angeles. F. M. FOSTER, who has been elected a vice president, takes over Mr. Jacobs' responsibilities concerned with sales and customers functions. P. R. SHEA, who has been serving as general staff supervisor in the sales department, will succeed Mr. Foster as general sales manager.

P. R. Shea
So Cal

L. B. Bonnett
Con Ed

LELAND B. BONNETT, vice president of Consolidated Edison Co. of New York, retired on Dec. 1 after 31 years with the company. At the time of his retirement, Mr. Bonnett was in charge of design engineering. Over the years, planning, engineering, inventory, and purchasing and stores operations have been directed by him.

ROBERT P. BROOKS has been promoted to northwestern sales manager for Bucyrus-Erie Co., covering the states of Washington, Oregon, Idaho, and Montana, the Territory of Alaska, and the provinces of British Columbia and Alberta, and the Yukon territory.

C. D. SHANKS has been promoted to the post of resident engineer of Bailey Meter Co., Cleveland, with headquarters in Charleston, W. Va.

EUGENE D. PETTLER is now resident field engineer in charge of the newly formed Seattle (Wash.) district office of CEC Instruments Inc.

H. S. ROSE, who has been president of United Natural Gas Co., Oil City, Pa. since 1950, has announced that he will retire from active service when his present term of office expires on Jan. 20.

HENRY M. CHANCE II has been elected president of United Engineers & Constructors Inc., Philadelphia. He has been associated with the company for 18 years.

J. A. ENGLISH has been named manager of the Philadelphia Electric Co.'s emergency procedures division, a unit created to review, improve, and establish new emergency operation procedures. Other appointments include: J. HENRY LONG, general superintendent of the gas department, succeeding Mr. English; E. K. CORNELIUS, superintendent of gas production; C. D. BUCHHOLZ JR., superintendent of gas production at West Conshohocken, Oreland, and Pottstown; and E. F. BERGEY, plant superintendent of the West Conshohocken gas plant.

EDWARD J. ROMMEL has succeeded LEONARD M. HOLMES, who is retiring, as acting commercial manager of the Dayton (Ohio) Power & Light Co.

JOHN H. MACKENZIE has been elected assistant treasurer of United

A TRIPLE THREAT

to your operating efficiency

Unless this rampaging menace is stopped short of the goal, your engines, your equipment and your entire processing system will remain vulnerable to its attacks.
H_2S can be stopped — dead in its tracks — by America's most effective, most economical, most proven gas purification method known today — Connelly IRON SPONGE! Yes, this simple, high-capacity product can be depended upon to cleanse any flow—at high or low pressure—of hazardous Hydrogen Sulphide . . . and also to lower operating and maintenance costs. IRON SPONGE renders this service prolongingly — subject to easy rejuvenation.
Despite its thoroughness and over-all superiority, Connelly IRON SPONGE spreads its low cost thin through each 1000 feet of gas. To get the full facts about this effective purifier, write, wire or phone Connelly — today. Our engineering department is at your service.

Connelly IRON SPONGE

PRODUCT OF
CONNELLY, Inc.
3154 S. California Ave., Chicago 8, Illinois
Elizabeth, N. J. • Los Angeles, Calif.

Gas Improvement Co., Philadelphia, succeeding EARNEST MACMORRIS, who is retiring. The company has also named KENNETH B. ANDERSON as general counsel, succeeding GARFIELD SCOTT, who is also retiring.

C. D. PENDERGRAST has been named director of publicity for the Northern Illinois Gas Co., Chicago.

Promotions at Laclede Gas Co., St. Louis, include: ALLEN H. BURGESS, vice president and general superintendent, now vice president in charge of operations; E. L. RAMSEY, vice president in charge of industrial relations; R. J. VANDAGRIFF, vice president in charge of sales; and JOHN J. MCKEARIN, sales manager.

E. C. MCANINCH, Ardmore district vice president of Oklahoma Natural Gas Co., has been promoted to vice president of the Tulsa district. EARLE E. GARRISON succeeds him at Ardmore.

ROBERT W. HUMES, advertising and sales promotion manager of Sherman Products Inc., Royal Oak, Mich., has been promoted to the post of assistant sales manager. The company has also appointed DONALD C. ZUHLSDORFF as assistant advertising and sales promotion manager.

R. W. Humes
Sherman

N. H. Gellert
Seattle

N. HENRY GELLERT has resigned as president of Seattle (Wash.) Gas Co. effective March 15. Mr. Gellert, who will remain as a consultant to the firm, will be succeeded as president by WALTER BYRNE, now a member of the board.

E. GEORGE BAKER has been promoted to the position of assistant sales manager of the Mueller Co.'s Los Angeles plant, where he will be in charge of all sales personnel.

RICHARD B. BARGER has been promoted to the post of New York regional manager for General Controls Co., Glendale, Calif.

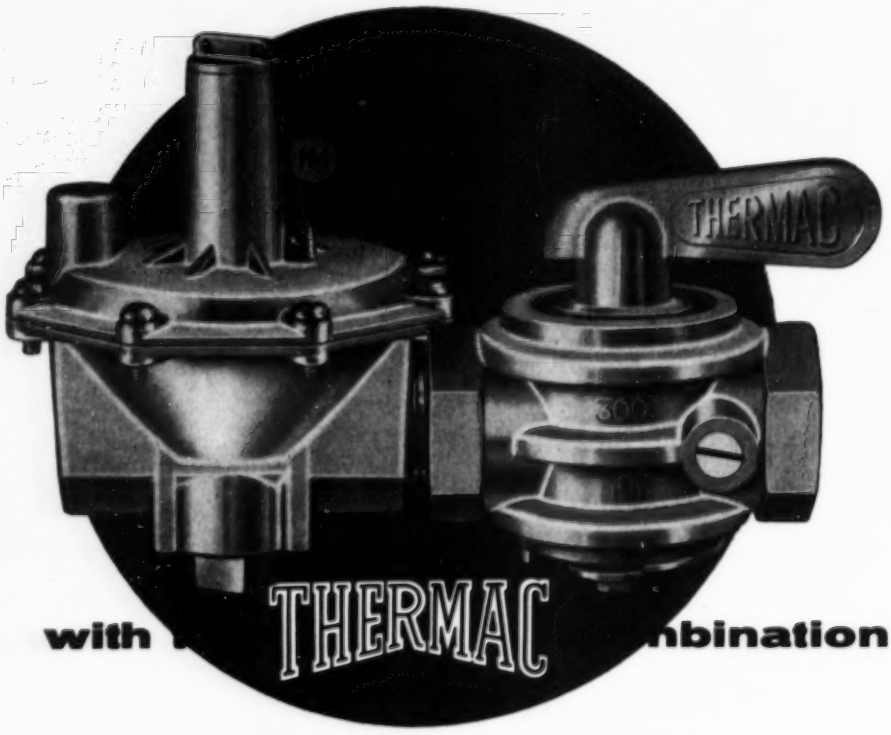
SPENCER H. MIERAS and KENNETH W. FOUST have been elected to the board of directors of Bonney Forge & Tool Works, Allentown, Pa. In addition, Mr. Mieras was elected to the post of executive vice president.

LUSTER L. STARRETT, a division commercial manager for Commonwealth Edison Co., and CHARLES W. DANIELS, a division supervisor of general service, have been elected treasurer and assistant treasurer, respectively, of Northern Illinois Gas Co., Chicago.

Lone Star Gas Co., Dallas has promoted H. D. PORTWOOD to the post of superintendent of distribution of the general division of distribution and R. E. READING to chief engineer of the same department; J. B. REESE and BEN E. THOMSON to general sales and promotion managers for the Waco and Greenville divisions, respectively; and AMOS D. BOYETT to division supervisor of the Greenville dealer assistance department.

Robertshaw-Fulton Controls (Canada) Ltd., Toronto, has elected JOHN A. ROBERTSHAW, president; GEORGE A. ELLIOTT, vice president and general manager; WALTER H. STEFFLER, secretary and treasurer; B. T. TAYLOR, comptroller; and H. WILIAM BIGGAR, assistant secretary and assistant treasurer.

beat today's high costs



with ... combination

Install this assembly and forget it — the most economical combination of Regulator and Valve on the market today. By combining these two universally accepted products, the Thermac Appliance Regulator with Thermac's specially heat-treated aluminum alloy gas shut-off valve, an unusually low cost assembly is assured.

The Regulator itself — the Thermac "T" Series, is very simply and ruggedly designed with so few parts it is practically fool-proof. High in capacity — easy to install in cramped and crowded quarters. Easy to service without removal from line. All these features plus universal acceptance by *leading* appliance builders means that your selection of Thermac will be highly regarded wherever your appliances are sold.

Compare these fine products in any way you choose — performance, quality and price — and you will choose Thermac. Get full information on the above assembly today.

THERMAC COMPANY

800 East 108th Street • Los Angeles 59, California

"Over 23 years' experience building gas controls"

B. T. Franck
Milwaukee Gas

L. R. Cousland
Orbit Valve

B. T. FRANCK, who has been vice president in charge of sales for Milwaukee (Wis.) Gas Light Co. since 1949, has resigned. Sales activities will now be under the direction of JACK MIKULA, general sales manager.

New faces

LEON R. COUSLAND has joined Orbit Valve Co., Tulsa, as the company representative in Kansas and the Texas Panhandle. He will headquarter in Liberal, Kan.

G. ALBERT RHIMER has joined the Geo. D. Roper Corp., Rockford, Ill., as Philadelphia (Pa.) district manager, covering Philadelphia and Bucks, Montgomery, Chester and Delaware counties.

CHARLES E. RUELLE has been promoted to appliance service engineer at Hamilton Manufacturing Co., Two Rivers, Wis.

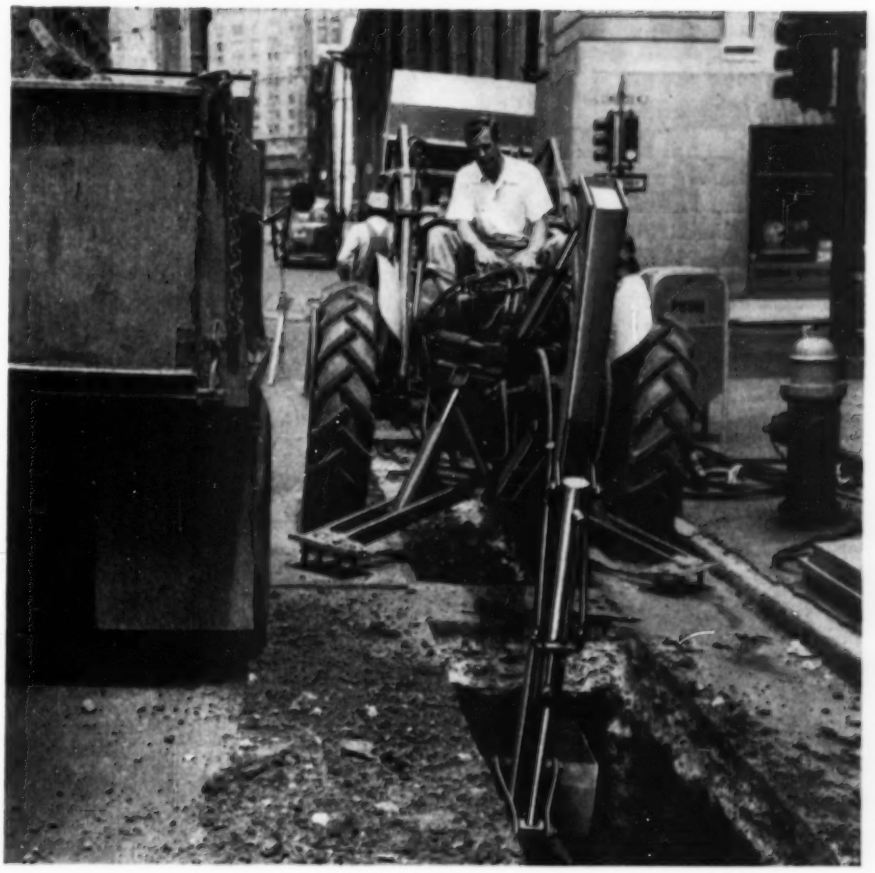
LEVIN P. HANDY has joined the Anaheim (Calif.) division of Robertshaw-Fulton Controls Co. as area field engineer in San Diego, Calif.

LEE W. RASCH, formerly president of Rasch Manufacturing Co., Kansas City, Mo., has joined Temco Inc. as manager of the central heating division of the Nashville (Tenn.) company.

ROBERT T. HLAVIN, formerly sales manager of the industrial products division of Detroit Brass & Malleable Co., has joined the sales staff of the Maxitrol Co., Detroit.

L. W. Rasch
Temco

R. T. Hlavin
Detroit Brass



Make Emergency Repairs Faster with a Sherman Power Digger!

The job: Break up 3" of asphalt and 8" of concrete with air tools, then dig bellholes 5 feet deep for repairs to underground conduit. The location: A busy street, where traffic congestion must be kept to a minimum, repairs made, and the street re-paved for traffic to resume as soon as possible.

The solution: A Sherman Power Digger. Its actuated shovel action made it possible to dig an under-cut bellhole to the required depth with a small surface opening, thus keeping later street re-surfacing cost to a minimum. The tractor-mounted digger traveled to the site under its own power, dug at a fraction of the cost of hand labor, and saved considerable time by loading spoil directly into trucks from the excavation.

If you now excavate by hand or with machines too clumsy for jobs like this, investigate the Sherman Power Digger. It's compact, flexible, fast, easy to operate. It costs little to buy, less to maintain, quickly pays for itself. Write today for Bulletin No. J17.

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SHERMAN PRODUCTS, Inc.
Royal Oak, Michigan
WAIN-ROY CORPORATION
Hubbardston, Mass.

Patent No. 2,303,852
Other patents pending
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Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN

Deaths

KENNETH L. DAWSON, 61, past president of the Canadian Gas Association died in November. He was an executive of the Nova Scotia Light & Power Co.

L. S. ZIMMERMAN, chairman of the board of directors of the Houston (Texas.) Natural Gas Corp., died last month. A director of the company since its organization in 1925, Mr. Zimmerman became chairman of its board in 1940.

GAS associations

U. of Houston to be scene of corrosion short course

Fundamentals of pipeline corrosion will be the subject of a two-day short course conducted by the Houston section of the National Association of Corrosion Engineers, Jan. 20-21. The course, planned for foremen, superintendents, field personnel and beginning corrosion engineers, will be held at the University of Houston.

The practical aspects of pipeline corrosion will be stressed. What causes pipeline corrosion and what can be done about it will be shown by demonstration units, field trips, and through non-technical talks by experts. Subjects included will be internal and external corrosion of pipelines, internal and external coatings for pipelines, use of inhibitors for oil and gas pipelines, and some case histories of pipeline corrosion, both internal and external.

C. L. Woody of United Gas Corp. is chairman of the short course.

H. Carl Wolf resigns as head of AGA staff

H. Carl Wolf

H. Carl Wolf, managing director of the American Gas Association since 1945, is relinquishing his position as active head of the association's staff, because of continued illness. He will be available to the association in the capacity of a consultant as circumstances may require. Since June 1954, Mr. Wolf has been on leave of absence from the association.

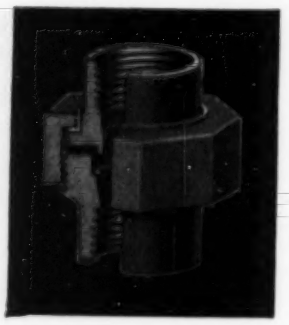
John W. West Jr., who has been acting manager director during Mr. Wolf's absence, will continue in that capacity until the matter of a permanent appointment has been finally determined by the board of directors.

Electronic accounting to be subject of research

A program for research in the field of electronic utility accounting was outlined at a recent meeting of a joint steering committee of the American Gas Association and the Edison Electric Institute.

The object of the program is to evolve design specifications for automatic utility accounting systems. As a first step, the staff of the computation laboratory at Harvard University will undertake investigations toward the design of a system for automatic customer accounting.

It is proposed that a total of $100,000, half of which is to be provided by each association, be made



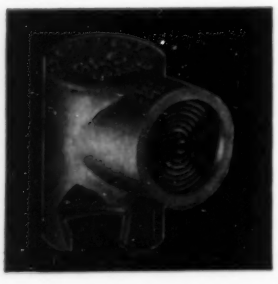
New CRANE Malleable Iron Insulated Union

Gives cathodic protection at meters—Galvanic corrosion in service piping can be effectively reduced by cathodic protection at meter connections. This rugged, malleable iron Crane union breaks the current path by means of special insulation.

Between union ring and tail-piece there's an L-shaped washer of laminated phenolic thermosetting plastic. Between tail-piece and thread-piece a thick black rubber gasket breaks the metal-to-metal contact. Both insulating parts have high dielectric strength.

New union measures just slightly longer than the regular ¾-inch Crane malleable union—approximately 2-7/32 inches, end to end. Packaged in cartons of 30.

Check your Crane Representative on these items!



New ¾-inch Safety Vent Elbows

A flexible stainless steel coil spring takes the place of the old bar grille or rigid screen in this new Crane vent elbow. Keeps out bugs, insects, foreign matter. Flexes outward if regulator is vented. Durable, dependable—die cast of zinc alloy.

CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

available for the work over a three-year period, which commenced Oct. 1, 1954, to be expended at a rate not to exceed $33,000 per year without prior approval from the sponsors. In the discretion of the sponsoring organizations, the project would be subject to termination after two years' work, but not before.

GAMA's industrial gasmen register trademark

The "signer seal" of the industrial gas equipment division of the Gas Appliance Manufacturers Association has been registered as a trade mark with the U. S. Commissioners of Patents and its Canadian counterpart.

The seal, which may be used by member companies on their products, letterheads, labels, name plates, etc., and in advertising, indicates that the manufacturer agrees to comply with the division's self-imposed code of ethics, which calls for "the highest standards of safety, performance and durability" in industrial gas equipment.

Hotel men see large gas display during exposition

Eleven manufacturers of commercial cooking equipment and allied products occupied the gas area at the 39th National Hotel Exposition held recently. The cooperating exhibitors in the AGA combined commercial gas exhibit, sponsored by the industrial and commercial gas section, comprised the largest single exhibit at the show, held at Kingsbridge armory, Bronx, N. Y.

A tradition during the hotel show, the 7th annual commercial gas breakfast was held at the Hotel Roosevelt, with nearly 100 commercial gasmen, manufacturers of commercial cooking equipment, and representatives from the volume feeding field and hotel and restaurant associations in attendance.

Educational lectures to highlight NACE meeting

• Two educational lectures on corrosion, "The Diagnosing of Corrosion Problems," and "Corrosion of Liquid Metals and Fused Salts," will be given at the 11th annual conference and exhibition of the National Association of Corrosion Engineers, March 7-11, 1955, at the Palmer House, Chicago.

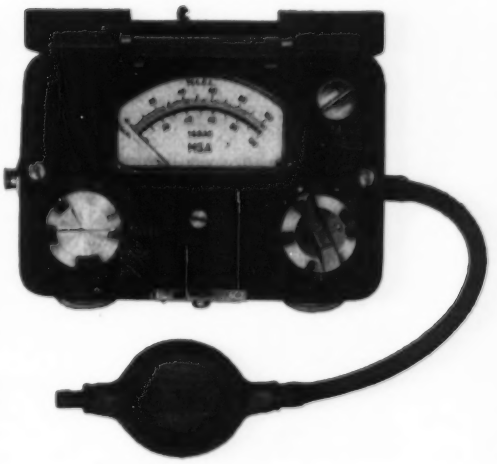
V. V. Kendall, corrosion engineer, National Tube Division, U. S. Steel Company, Pittsburgh, will talk on the diagnosis of corrosion problems. The corrosion lecture on liquid metals and fused salts will be given by W. D. Man-

% L.E.L.
% GAS
This setting gives you 0 to 100% of lower explosive limit
. . TURN THE SWITCH
% L.E.L.
% GAS
This setting gives you 0 to 100% by volume of combustible gas

This New Simplicity
—New Versatility
in ONE instrument
...the M·S·A GASCOPE

The illustration above shows you how, with the simple turn of one selector switch, the M.S.A. Gascope gives you both high sensitivity for the detection of low gas concentrations, and immediate, quantitative response for tracing higher concentrations of gas to its source. Separate scales for each range are calibrated on the fan-shaped meter in the center of the instrument. Each scale is divided by 50 graduations to permit accurate, fast readings.

This dual-range, direct reading instrument is the modern answer to fast, dependable detection and location of gas concentrations over the entire range from 0 to 100% by volume. Write for details, or ask for a demonstration. Your request will be handled promptly.



The Gascope is light, comfortable, and demands no special skill to operate. A variety of accessories are available to meet all sampling conditions.

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SAFETY EQUIPMENT HEADQUARTERS

Call the M.S.A. man on your every safety problem... his job is to help you

MINE SAFETY APPLIANCES CO.
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At Your Service: 76 Branch Offices in the United States
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Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.
Representatives in Principal Cities in Mexico, Central and South America
Cable Address: "MINSAF" Pittsburgh

ly, Oak Ridge National Laboratory, Carbon and Carbide Chemicals Co., Oak Ridge, Tenn.

A chemical inhibitor symposium consisting of two papers, one on evaluating, the other on screening inhibitors will also be held.

The two papers and their titles are: "The Use of the Pearson Bridge in Corrosion Inhibitor Evaluation," by E. J. Simmons, Sun Oil Co., Dallas, and "The Development of a Standardized Laboratory Method for Screening Corrision Inhibitors," by J. C. Spalding, Sun Oil and Edward C. Greco, United Gas Corp., Shreveport.

Promotion and sale of built-in gas ranges, gas clothes dryers, incinerators, and refrigerators, in addition to discussions of company problems and dealer programs, were highlighted at the recent western area residential sales roundtable conference of the Southern Gas Association. Sponsor was R. P. Hill, MidSouth Gas Co. (seated fifth from left).

Blue Flame group elects for coming year

Frank Soldan, sales manager of Kansas-Nebraska Natural Gas Co., Hastings, Neb., has succeeded Herbert Nelson of Northwestern Public Service Co., Grand Island, Neb. as president of the Blue Flame Gas Association.

Speakers at the annual convention, which was held last month in Grand Island, included L. C. Ginn, of the Coleman Co.; Harold Jalass, Cribben & Sexton Co., H. Vinton Potter of the AGA; and Carl Olson, Central Electric & Gas Co. Mr. Olson presented the plans for the promotion of the 1955 Mrs. America program in Nebraska. He reported that all of the gas utilities in the state have signed up for the program.

Largest exhibit boasted by AGA at metal show

Once again the industrial and commercial gas section of the AGA had the largest single exhibit at the recent National Metal Congress and Exposition held in Chicago.

With 200 ft on one side of a main aisle in the arena and 100 ft of space across the aisle, 11 manufacturers of inndustrial heating equipment and allied products made up the AGA combined industrial gas exhibit. Occupying nearly 4000 sq ft, this was the largest

Lancaster S-7 GROOVE TYPE METAL RIM DIAPHRAGM

Performance advantages of the Lancaster S-7 mean a closer to 100% overall accuracy — and an extra margin of profit. Patented Lancaster features and superior quality construction add up to more years of service in the meter — and another margin of extra profit.

If you are not using the Lancaster S-7 groove type metal rim diaphragm for your small meter repairs and replacements, write for a sample today.

Lancaster METER PARTS CO.

POST OFFICE BOX 378 • LANCASTER, OHIO

exhibit the gas industry has ever had at a metal show.

More than 100 industrial gasmen, manufacturers of industrial gas equipment and metalworking representatives attended the 18th annual industrial gas breakfast, always held during metal show week.

Another event held at the same time as the show was the fall meeting of the industrial gas council, which saw Surface Combustion Corp.'s colored film "Genie of the Flame," and heard talks by R. J. Reed of North American Manufacturing Co. on "Selecting Dual Fuel Burners Where Oil Standby Is Required" and George R. Hamilton Jr., U. S. Steel, on "The Use of Industrial Fuel in Steel Plants."

GAS association notes

Dr. Gordon N. Scott, consulting engineer in Los Angeles, and W. H. J. Vernon of England have been selected to receive 1955 NACE awards, to be presented during the association's 11th annual conference and exposition in Chicago, March 7-11. Dr. Scott will receive the Frank Newman Speller award for achievements in corrosion engineering and Mr. Vernon will receive the Willis Rodney Whitney award for achievements in the field of corrosion science.

The American Trade Association Executives has presented the AGA with a certificate of recognition for meritorious contributions to the advancement of trade association management. The certificate was awarded in recognition of the excellence of the entries in the ATAE distinguished service contest. AGA entered its dealer sales program, "Pattern For Profit," and its school education program.

By a heavy total vote of 4081, a majority of 5919 eligible voting members of the American Society of Heating and Ventilating Engineers expressed their approval of changing the name of the 60-year-old engineering society to American Society of Heating and Air-Conditioning Engineers.

A Completely NEW LINE of Service Bodies with

25 FEATURES

that give a new meaning to "UTILITY"

1. Models to fit 40 different Chevrolet, Ford, International, GMC, Dodge and Studebaker chassis . . . single or dual wheel.
2. For ½ - ¾ - 1 - and 1½-ton trucks.
3. 18 different compartment arrangements.
4. Exclusive 4-point coil spring body mounting.
5. Complete line of Service Accessories.
6. Bonderized, all-steel welded construction.
7. Double lap-type joints.
8. Extra-wide doors for easy access.
9. Larger, greater capacity compartments.
10. Embossed door panels for rigidity and appearance.
11. Fully recessed door handles.
12. All doors keyed alike.
13. Tumbler-type locks at no extra cost.

Model 900 D with upper structure

Model 1050 D

14. Full bolt-action locking bar.
15. Weatherproof compartments . . . lap-seal and gutter drain on all doors.
16. Raised bottoms of all vertical compartments provide extra protection for tools and supplies.
17. Heavy-duty reinforced 16-gage bulkheads.
18. Outside compartment headers 14-gage steel.
19. 4-way, 12-gage, safety tread non-skid floor.
20. From 25 to 35 sq. feet of floor loading area.
21. Through wheel housings for universal dual wheel application.
22. Reinforced tailgate.
23. Extra strength, bridge-type construction with interlocking lateral and longitudinal reinforcements.
24. Side boxes supported by one-piece cross members, reinforced at mounting holes.
25. Beaded fender panels hinged for easy access to wheels and spring shackles.

For Better Service and Greater Utility . . . Specify

Morrison service bodies

WRITE FOR DETAILS:

Morrison Service Body Division
MORRISON STEEL PRODUCTS, INC.
696 Amherst Street Buffalo 7, New York

• Also manufacturers of MOR-SUN Furnaces and ROLY-DOOR Steel Garage Doors

GAS abstracts

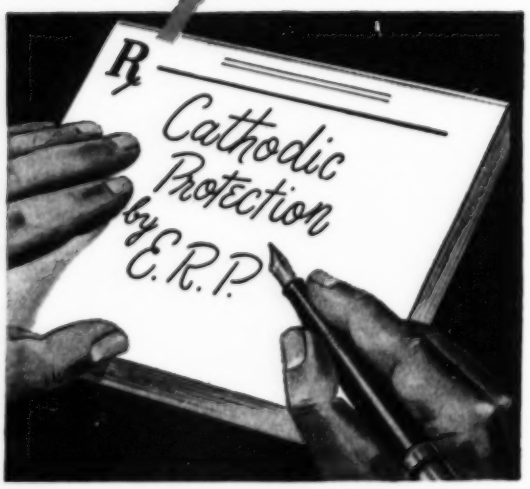
PRODUCTION OF NATURAL GAS SUBSTITUTES BY PRESSURE HYDROGASIFICATION OF OILS—An IGT interim report by H. R. Linden, J. J. Guyer, and E. S. Pettyjohn.

In a laboratory study of pressure hydrogasification with a 2½-in. ID cracking tube, oil gases were produced from three typical gas-making oils at gasification pressures of 1 to 5 atmospheres, cracking temperatures of 1350° to 1550° F, residence times of 2.5 to 10.5 seconds, and hydrogen-oil feed ratios of 0 to 90 scf/gal. The effects of these operating conditions and of the oil properties on the Btu recoveries in the form of stable high-Btu oil gas, and on the yield and compositions of the gaseous and nongaseous products, are presented in graphical form.

Data on the substitutability, for high-methane natural gas, of the gases produced by pressure hydrogasification are reported, and burner test results are

Continued on page 100

Rx FOR CORROSION...



You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required *to* achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been successfully protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

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GAS calendar

January

13-14..NEGA Accounting Division—Hotel Statler, Boston.

17-19..7th Annual Convention, Pipe Line Contractors Association—Statler Hotel, Los Angeles.

18..NEGA Operating Division—Hotel Statler, Boston.

20-21..Pipeline Corrosion Short Course (Houston section, NACE) — University of Houston (Texas).

21..SGA Employee Relations Roundtable — Nashville.

24..SGA Air Conditioning Sales Conference — Adolphus Hotel, Dallas.

24-26..AGA Home Service Workshop—Drake Hotel, Chicago.

26-28..Instrumentation for the Process Industries Symposium—Texas A&M College, College Station, Texas.

27-28..Fourth Annual Instrument Short Course (Southern California Meter Association) Los Angeles Harbor Junior College, Wilmington, Calif.

27..NEGA Accounting Division—Hotel Statler, Boston.

28..SGA Accident Prevention Roundtable—Heidelberg Hotel, Jackson, Miss.

28..SGA Air Conditioning Sales Conference—Heidelberg Hotel, Jackson, Miss.

28..Pennsylvania Gas Association, Mid-Winter Sales Conference—Benjamin Franklin Hotel, Philadelphia.

February

4..SGA Work on Consumers' Premises Conference — Biltmore Hotel, Oklahoma City.

11..NEGA Manufacturer - Distributor Division — Hampshire House, Boston.

13-15..24th Annual Mid-Winter Conference of Public Utility Buyers' Group, National Association of Purchasing Agents — Shamrock Hotel, Houston.

23-24..PCGA Seminar on Electronic Data Processing — Los Angeles.

25..NGAA Permian Basin Regional Meeting—Scharbauer Hotel, Midland, Texas.

March

4..SGA Transmission Management Conference—Shamrock Hotel, Houston.

7-9..Mid-West Gas Association—

St. Paul Hotel, St. Paul, Minn.

7-11..National Association of Corrosion Engineers — Palmer House, Chicago.

9-10..PCGA Customers Service Conference—Carmel, Calif.

16-17..PCGA Home Service Conference—Santa Monica, Calif.

17-18..SGA—Jung Hotel, New Orleans. Accounting Management Conference; Distribution Management Conference; Sales Executive Conference.

23-24..PCGA Accident Prevention Conference—Santa Barbara.

24-25..NEGA Annual Meeting — Hotel Statler, Boston.

24-25..Oklahoma Utilities Association Convention — Mayo Hotel, Tulsa.

April

28-1..Western Metals Congress and Exposition—Los Angeles.

12-14..AGA Sales Conference on Industrial & Commercial Gas —Hotel Statler, Boston.

12-15..AGA Distribution, Motor Vehicles & Corrosion Conference — Netherland Plaza, Cincinnati.

18-19..AGA Residential Gas Section, Eastern Natural Gas Regional Sales Conference—Hotel William Penn, Pittsburgh.

19-21..Southwestern Gas Measurement Short Course—University of Oklahoma, Norman.

20-22..Indiana Gas Association Annual Meeting — French Lick Springs Hotel, French Lick, Ind.

25-27..National Conference of Electric and Gas Utility Accountants — Conrad Hilton Hotel, Chicago.

25-27..Mid-West Regional Gas Sales Conference—Edgewater Beach Hotel, Chicago.

May

2-6..AGA Industrial Gas School—Hotel William Penn, Pittsburgh.

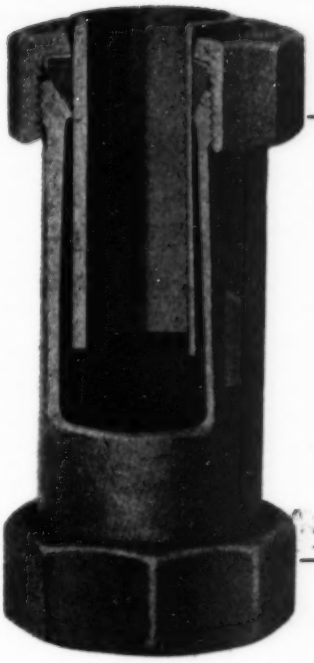
9-10..AGA Gas Supply, Transmission & Storage Conference—William Penn Hotel, Pittsburgh

12-13..Public Utilities Advertising Association—Sheraton Hotel, Chicago.

16-18..Southern Gas Association — New Orleans.

17-19..Pennsylvania Gas Association —Pocono Manor Inn, Pocono Manor, Pa.

23-25..AGA Chemical, Engineering & Manufactured Gas Production Conference — Hotel New Yorker, New York.



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related to gas composition. The combustion tests were conducted at approximately rated burner heat inputs using the five critical appliance burners employed in previous studies of oil gas-natural gas substitutability.

The gasification and burner test data obtained in this study of oil gas production in the presence of feed hydrogen serve to extend the published laboratory studies of high-Btu oil gas production at atmospheric and moderate pressures, and high-Btu oil gas-natural gas substitutability. These data also provide a basis for application of the novel pressure hydrogasification process to the design of plants for the production of complete natural gas substitutes.

PRODUCTION OF HIGH-BTU OIL GASES FROM CRUDE SHALE OILS —An IGT interim report presents experimental data obtained in the thermal gasification of two typical crude shale oils in a 2.51-in. ID externally heated laboratory cracking tube over a range of cracking conditions resulting in the production of gases with heating values from 9000 to 1500 Btu/scf. Runs were made at atmospheric pressure, using steam for atomization and partial pressure control, at cracking temperatures from 1400° to 1550° F, and residence times from 2 to 4.5 seconds.

The effects of severity of cracking on Btu recoveries in the form of stable product gas, and on the yields and compositions of gaseous and nongaseous products, are outlined in graphical form, and the gasification results for crude shale oils are compared with similar data obtained for typical distillate and residual petroleum oils in earlier studies. The true (inert-free) product gas heating value is used to define the severity of cracking as determined by cracking temperature and residence time.

Data are presented on the substitutability of scrubbed shale oil gases, after dilution with inerts to give rated heat inputs, on critical appliance burners adjusted for high-methane natural gas. These data are correlated with the inert-free product gas heating value at various primary air adjustments, and are compared with equivalent results for high-Btu oil gases.

TRENDS IN GAS TRANSMISSION-COMPRESSOR CYLINDER DESIGN AT COOPER-BESSEMER—Presented by W. Hartwick of Cooper-Bessemer Corp. at the Oil & Gas Power Conference of the ASME in Kansas City, Mo., June 14-17, 1954.

Major improvements and innovations that have contributed to the development of modern compressor cylinders for the transmission of gas are:

1. Increased valve areas in consecutive cylinder designs through the use of more and/or larger valves. Increased gas-passage areas and nozzle sizes accompanied these improvements.
2. Introduction of double-deck valves with the resultant increase in valve area and ease of providing additional fixed and adjustable clearance.
3. Introduction of high clearance cylinders with their attendant flexibility. Practical high clearance cylinders were made possible by the double-deck valve and its associated special clearance devices.
4. Utilization of high-strength cast iron.
5. The use of laminated thermosetting plastic materials for compressor rings, rod packing, and valve plates.
6. Elimination of water-cooling with the resultant simplification of cylinder and station design.

Since compressor performance is a function of both cylinder design and piping, the importance of providing properly designed piping is apparent. The influence of piping on compressor performance necessitates special care in evluating cylinder efficiency inasmuch as inefficiencies attributable to piping must be separated from those chargeable to cylinder design.

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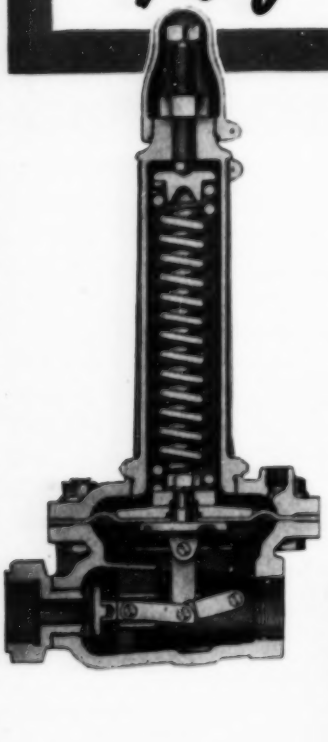
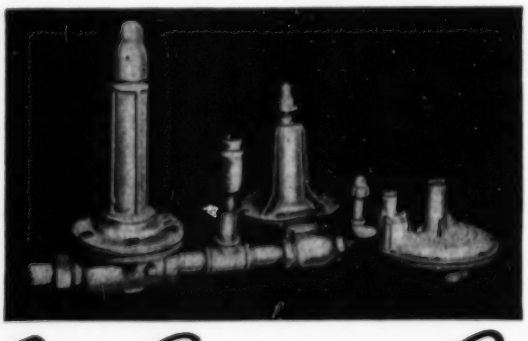


Accurate, Safe Control

of tremendous pressures is an ever present problem in the gas field. Reynolds field Regulator illustrated at left is one of the many high pressure regulators built by Reynolds. It is thoroughly tested and proved in service. It handles up to 1,000 pounds safely reducing same to pounds. For more than fifty-five years Reynolds has designed and built gas regulators. Safety, accurate performance, years of service—these are some of the built-in factors responsible for Reynolds enviable position in the Gas Control Field.



Reynolds Gas Regulator Co.
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GAS CONTROL SINCE 1892

THE ALLEVIATION OF COOLING-WATER PROBLEMS — USE OF AUTOMATIC SULFUR - BURNING EQUIPMENT — Presented by J. T. Russell of Panhandle Eastern Pipe Line Co. at the Oil & Gas Power Conference of the ASME in Kansas City, Mo., June 14-17, 1954.

A fully automatic installation for treating cooling water is described. This requires only weekly tests for supervising treatment, and has reduced costs of chemicals from 50 to 75% below former treatments. Only two treating chemicals are used; namely, sulfur and a corrosion inhibitor. Sulfur is burned in a specially designed burner, with the rate of burning regulated by a recording pH controller. The corrosion inhibitor serves also as an algaecide and bacteriacide so that by the use of these two treating chemicals a means has been found of alleviating the most important cooling-water problems.

The vast majority of cooling-water problems may be classified under the following headings: scale deposition; corrosion in the cooling-water systems; deterioration of cooling-tower wood brought about by contact with the cooling water; and fouling by growths of algae and/or slime-producing bacteria.

A SUMMARY REPORT OF PROJECTS DEALING WITH THE DETERIORATION OF COOLING-TOWER LUMBER — Presented by Donald R. Baker of the Marley Co. at the Oil & Gas Power Conference of the ASME in Kansas City, Mo., on June 14-17, 1954.

Chemical attack is closely related to the composition of the circulating water. The composition is subject to control through water treatment, but cost does not always make this practical. The operator can avoid practices that increase the rate of chemical attack, such as excessive chlorination or the use of sodium-zeolite softeners that produce sodium carbonate. Sulfuric acid can be used to lower the pH-value and decrease the alkalinity, but there are many instances where the cost of treatment will exceed the cost of replacing lumber in the tower.

Chemical attack renders the wood susceptible to decay, and there is evidence to indicate that the lumber in most cooling towers soon becomes vulnerable to attack. Laboratory tests indicate that the composition of the circulating water in most towers should not cause serious chemical attack. There is considerable evidence to indicate that much of the deterioration commonly attributed to chemical attack is actually caused by decay organisms. If this is true, wood preservatives offer the possibility of preventing most of the deterioration in cooling-tower lumber.

"Baby Digger" truck loads in close quarters, has big capacity, digs up to 20" wide, 5' deep

This East Ohio Gas Company job, the replacement of a main extension, shows why the Cleveland Model 92 "Baby Digger" is so widely used for city digging. The "92" puts the edge of a trench within 17 inches of a parallel wall, loads excess spoil directly into trucks at the curb, and affords the operator full visibility of the whole job.

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CLEVELAND

Processing natural gas to distributing company specifications

GAS reviews

By GUY CORFIELD

IN most instances the supply of natural gas to distributing utilities comes from major sources through large transmission lines, and the gas quality specifications are a matter of negotiation and contract in terms of heating value and chemical composition with respect to inerts, contaminants, impurities, etc. Sometimes, however, the gas may come from local sources, or there may be local supplies (additional to the transmission lines) which the utility desires, or at least is not unwilling, to assimilate. Such local gas may be quite different in heating value or gravity from the main gas supply, or may contain impurities or contaminants that the local operator does not have equipment to remove.

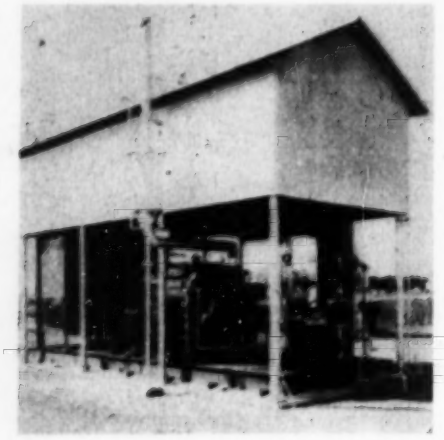

Fig. 1. Factory-unitized skid-mounted compressor unit.

If the quantity is very small in comparison to the mainline volume to which it can be added, the different heating value or gravity may not introduce utilization difficulties; impurities or contaminants, however, will always cause trouble. It appears logical, therefore, for the purchasing utility to require a reasonable standard of gas quality, or offer a purchase price low enough to compensate itself for the cost of necessary treatment.

An example of an arrangement whereby the Monterey Oil Co. undertook to process its gas for sale to the Southern California Gas Co. in compliance with the latter's specifications, is outlined in detail in a paper entitled "Monterey Oil Company Natural Gas Plant, Edison Oil Field, California" by Floyd E. Schoonover, Monterey Oil Co., Los Angeles, presented to the California Natural Gasoline Association annual fall meeting at Los Angeles on October 7-8, 1954. Details of the treating plant are quoted from Mr. Schoonover's paper.

Southern California Gas specified that the gas received be not less than 950 Btu/cu ft; contain less than 1.0%

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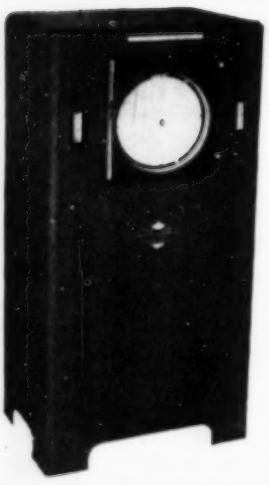

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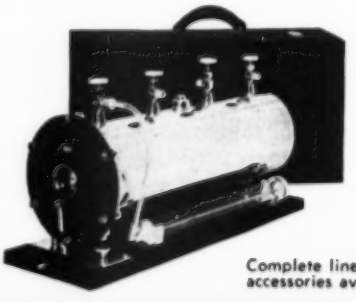

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air; contain not more than 5.0% carbon dioxide by volume; contain less than 0.3 grains hydrogen sulfide per 100 cu ft; contain no liquid water or impurities injurious to pipeline; and be limited to 2 MMcf/day except for emergency demands and not less than 500 Mcf/day.

The natural gas gathered from the field tank battery separators at 40 psig and 90° F at the rate of 2 MMcf/day, is compressed to such pressure as will insure processing and delivery at a pressure of not over 85 psig at the point of delivery. In the event of partial or complete gas failure from the 40 psig source (and for make-up) casinghead gas at 250 psig and 90° F is automatically admitted and controlled to maintain the process rate of 2 MMcf/day.

The 250-psig casinghead gas is not compressed, but is mixed with the compressed and cooled 40 psig trap gas downstream from the compressed gas cooler. The plant is so designed that the gas can be taken wholly from either source.

The combined and/or separate gas stream is then treated for the reduction of carbon dioxide content from 9.10% to not more than 5% by volume in the residue.

To meet delivery temperature and dew point, the gas is next dehydrated, resulting in a guaranteed dew point depression of 50° F.

A gas flow recording controller measures the plant effluent and controls the gas flow from the 250-psig source so as to maintain a constant processing rate of flow and in maintaining that rate of flow, a back pressure controller on the treated gas effluent is provided.

An automatic pressure controller to limit the compressor suction to 40 psig is provided to prevent unexpected shutdowns due to compressor intake overloading.

The compressor unit *(Fig. 1)* is a

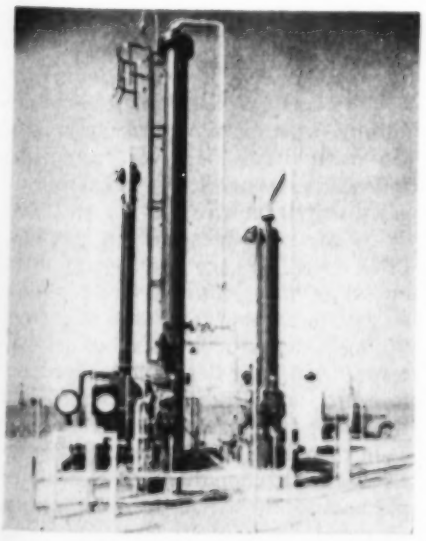
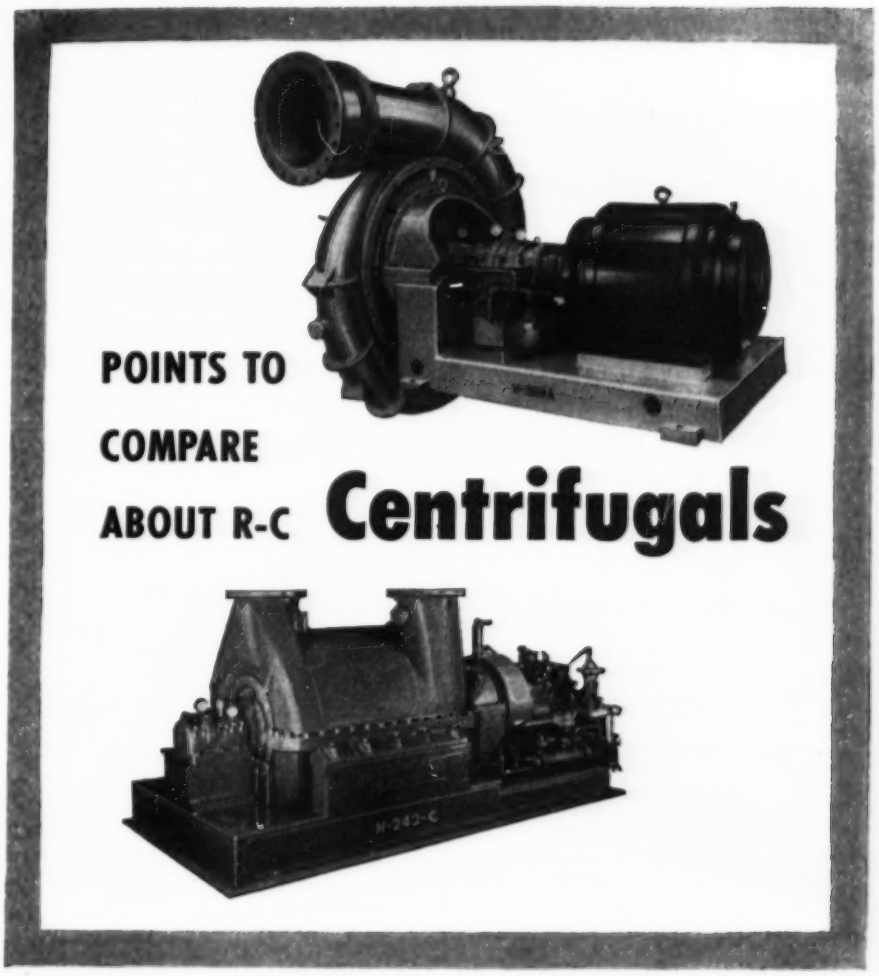


Fig. 2. Carbon dioxide removal unit.



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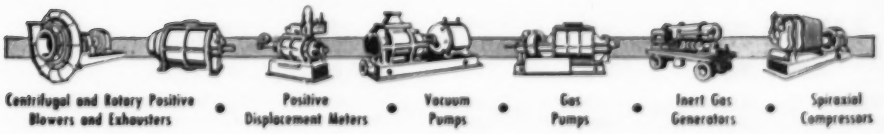

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factory-unitized skid mounted installation as designed and manufactured by Clark Bros. Co. It consists of a Clark, Model HMA-4 midget angle type, super two-cycle gas driven compressor. The prime mover is rate at 175 hp at 600 rpm, is composed of four vertical 8¼-in. bore x 8¼-in. stroke power cylinder directly connected to two 7¼-in. bore by 8¼-in. stroke horizontal cast iron double acting compressor cylinders.

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The carbon dioxide removal unit includes a Mono-ethanol amine-to-gas contactor *(Fig. 2)* complete with controls with a built-in high pressure gas scrubber in the bottom and a mist extractor and separator in the top. The design pressure is 250 psig, API-ASME Code, ⅛-in. corrosion allowance.

An amine still, with condenser, heat exchanger, and direct fired reboiler, complete with necessary surge tank, controls, and solution pump, is skid mounted as a unit. Design pressure is 14 psig, API-ASME Code, ⅛-in. corrosion allowance.

The mono-ethanol amine solution to the contactor is cooled in a coil submerged in water cooled by a Marley No. 103 unitized cooling tower of 10-ton refrigeration capacity. This tower is complete with float valve and water circulator pump.

The dehydrator unit includes a diethylene glycol contactor *(Fig. 2)* complete with a self-contained glycol cooler and mist extractor, with a design pressure of 250 psig, API-ASME Code, ⅛-in. corrosion allowance, and a glycol still, complete with reflux condenser section, direct fired reboiler, surge tank, and pump, on common skid base. The design pressure is 14 psig, API-ASME Code, ⅛-in. corrosion allowance.

The Monterey Oil Natural Gas Plant was placed on stream Feb. 12, 1954, at a cost of approximately $156,000. Minor changes in the equipment during the initial phase of plant operation resulted in some shutdown time but this was to be expected. Overall performance has been satisfactory. Plant shrinkage is estimated at 20%. The cost of operations is approximately $0.065 per Mcf, which includes operation expenses, depreciation, etc.

Methods of determining types of leakage

A PROBLEM of long standing, in natural gas distribution, is to determine whether street leakage is from the natural gas mains or from light hydrocarbon sources such as gasoline. A gas distribution area may be traversed by oil products lines carrying gasoline, LPG, "wet" gas, etc.; or storm drain openings may emit gasoline vapors washed in to them from spill-over from service stations, or sewer manholes may contain vapors of cleaning solvent, gasoline, etc., which has been dumped into the sewer system.

In manufactured gas areas it is relatively easy to identify the distributed gas because of its hydrogen and carbon monoxide content. A convenient means is to use an activated carbon filter as

an accessory to the combustible gas indicator; if the gas sample is passed through the carbon filter and then into the indicator, it will pass through the filter and be indicated if it is manufactured gas, but will be substantially absorbed in the filter if it is composed of gasoline or similar constituents. With natural gas, composed essentially of the two lightest hydrocarbons, methane and ethane, distinguishment from gasoline or similar vapors by activated carbon absorption is not so simple.

This problem has, of course, developed in the New England and other areas where natural gas has recently arrived, and is discussed in a very interesting manner in a paper delivered by J. T. McKenna Jr., staff engineer, Boston Consolidated Gas Co., to the fall meeting of the operating section of the New England Gas Association at Hartford, Conn., on Nov. 4, 1954.

Mr. McKenna describes experiments with two different grades of activated carbon, to determine their relative ability to absorb natural gas and gasoline vapors. His results, and the examination and adoption of a more dependable selective absorbent, are outlined in the following quotation from his paper:

Since Carbon I has almost no capacity for absorbing gasoline fumes, its use for distinguishing between gasoline and natural gas should not be contemplated. Carbon II shows an excellent capacity for gasoline vapors, but because it also has very good absorbing characteristics towards natural gas its use cannot be approved.

One other important conclusion is that all types of activated carbon do not react similarly in absorbing gasoline vapors, which poses the great difficulty of getting the right grade of activated carbon every time.

For this reason only a material that is easily obtained and that has a high degree of standardization could be considered. Further investigation using silica gel, a filtering material that meets these specifications, was undertaken. Silica gel is a hard, glassy, chemically inert, porous material. It is practically pure silica (SiO_2) with about 5½% water as part of its constitution when activated for use. Silica gel does not dust or erode during absorption or activation. It can be regenerated for further use by heating in a stream of air to 300-350° F. It is supplied in various mesh sizes, and is available in an indicating type. When deactivated, indicating silica gel changes from a deep blue to a light pink.

Indicating silica gel 6-16 mesh was the type used.

With natural gas, silica gel absorbs very little of the flammable mixture and within five squeezes of the aspirator bulb, 90% or better of the initial read-

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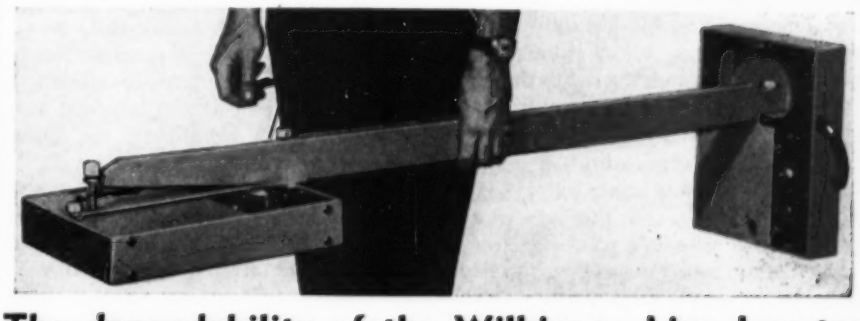

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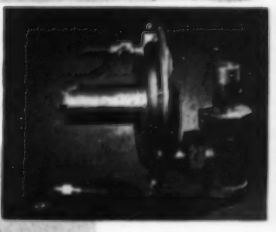

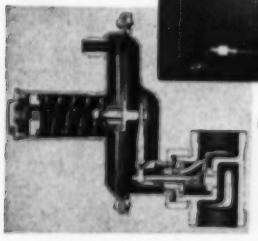

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ing is reached.

It does, however, have a large capacity to absorb gasoline vapor, large enough so that even after 50 squeezes the combustible gas indicator reads less than 50% of the initial reading on the instrument.

It is with this difference in the absorption properties of silica gel for natural gas and gasoline that we intend to identify combustible gas mixtures found in the field.

The following method of leak identification is proposed:

First, any combustible gas indication must be checked as to its nature by passing the gas through the combustible gas indicator until a steady reading is reached. This reading is then noted.

Next, a filter containing approximately 25cc of indicating silica gel, 6-16 mesh is inserted in the sampling line at the combustible gas indicator and the contaminated atmosphere to be tested is then drawn through the combustible gas indicator by aspiration. After 10 aspirations the reading of the combustible gas indicator is again noted. If the reading obtained is between 90-100% of the original reading, the source of the leak is distributed natural gas. If, however, the reading is less than 50% of the original reading, the probable source of the leak is gasoline. Let me, however, note these precautions. If after 10 aspirations the reading on the combustible gas indicator is changing rapidly, several more aspirations should be made until a fairly stable reading is obtained. More than 10 aspirations may be necessary, e.g., if long sample lines have to be purged.

Care should also be taken to recheck the sampled atmosphere. After checking the contaminated atmosphere with the use of the filter, the reading should be checked again with the combustible gas indicator without any filter to see if the original reading can be repeated. If sample space, for example, a bar hole has a limited volume, the combustible gas mixture could be evacuated and the resulting air intake could be the reason for a low reading through the silica gel filter, a reading which normally would indicate the presence of gasoline fumes.

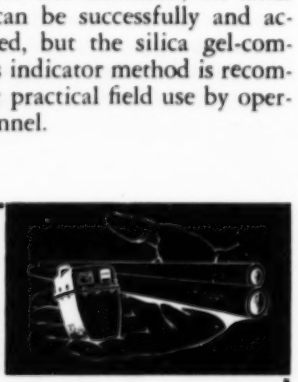
Still another precaution: silica gel, which has once been contaminated with gasoline vapors, holds onto the fumes and only releases them slowly to any air passed through the filter. For this reason, any filter which has been contaminated with gasoline vapors should be cleaned and replaced with a fresh charge of silica gel.

• • •

The paper further points out that this method will not distinguish between natural gas and marsh gas (methane, usually accompanied by high percentage of carbon dioxide): an Orsat is necessary in such cases. The use of a modified interferometer, and a thermal conductivity cell, are also discussed; the latter apparatus can be successfully and accurately used, but the silica gel-combustible gas indicator method is recommended for practical field use by operating personnel.

SHORT CUTS IN MATERIALS HANDLING: **6**

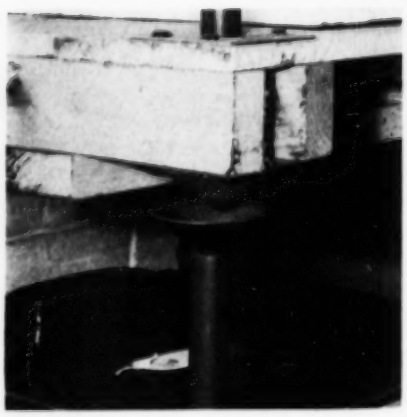
Paltier pallets



Michigan Consolidated Gas Co., Detroit, is using Paltier pallets that have inverted steel cones at each corner on the bottom and a steel plate with a socket hole above each cone on top of pallet for storage of unpackaged or uncrated material. The pallets are manufactured by Eastern Michigan Industrial Sales of Highland Park, Mich.

One steel post consisting of 1½-in. steel tubing with inverted cone on one end is inserted in each socket on lower pallet; second pallet is lowered into place with a fork lift, the inverted cones entering the cones on the posts and centering the unit.

AGA Materials Handling Subcommittee.



Close-up of cone and socket self-centering joint. Arrangement allows very little weave or sway under load.

GAS current reading

ASTM STANDARDS ON GASEOUS FUELS—The 1954 edition of this compilation contains in their latest approved form all of the ASTM test methods used in this field.

The test methods cover: measurement of gaseous fuel samples; sampling (natural, manufactured, and L. P. gas); analysis of natural gases by the volumetric-chemical method (natural gases and related types of gaseous mixtures by the mass spectrometer; carbureted water gas by the mass spectrometer; gaseous fuels, water vapor content, by measurement of dew-point temperature; calorific value, by the water-flow calorimeter; specific gravity); sulfur in petroleum products and liquefied petroleum gases by the CO_2-O_2 lamp method; vapor pressure of liquefied petroleum gases.

Of the 12 ASTM standards in the publication, five tentative test methods are new and five of the seven methods included in the previous edition have been revised.

Copies of this 184-page publication, heavy paper cover, can be obtained from the ASTM, 1916 Race St., Philadelphia 3. Price $2.50.

TWO-WHEEL HAND TRUCKS—This addition to the National Safety Council's safetygraph series outlines the proper maintenance and use of two-wheel hand trucks. It provides a ready means of training small groups in the operation of the trucks. Consisting of 12 spiral-bound pages, 18 by 24 in., inserted in a brown leatherette portfolio, the safetygraph can be set on any flat surface and opened to form an easel. On the pages facing the audience are clear and accurate drawings showing the proper maintenance and use. Notes for instructors are printed on the back pages.

Information on prices may be obtained from the National Safety Council, 425 N. Michigan Ave., Chicago 11.

NFI CATALOG (1953)—This 71-page catalog published by the National Foremen's Institute presents descriptions of loose-leaf manuals, booklets, and subscription services all dealing with employee relations, labor relations, and supervisory problems. The institute specializes in the production of supervisory training programs for management.

The catalog is available from the National Foremen's Institute, New London, Conn.

THE MANAGEMENT ISSUE

GAS

JANUARY 1955

DIGITAL COMPUTERS—

Their application to the gas industry's engineering problems

By J. FRED EBDON • Managing Editor

NEW tools for the gas engineer have been developed to satisfy the need produced by progress of the industry and the national economy. Not too long ago, it was economical to hire many people to perform mathematical computations with the standard tools, such as slide rules, tables, charts, and mechanical-electrical adding and/or calculating machines. The high-speed electronic computer is a relatively new tool that is revolutionizing engineering methods by freeing engineers from the routine volume mathematical tasks and making possible a form of numerical experimentation never before exploited.

It makes little difference whether these rapid computation devices are thought of as "electronic brains," mysterious monsters, or data processing mechanisms; they are here to stay. They are already an accepted tool of several gas transmission and distribution engineering departments and they have a vast potential for development and application.

The internal circuits and parts of electronic computers are beyond the comprehension of those not trained in this field; however—as in the case of standard desk-type calculators—it doesn't follow that one who may not understand the design inside their cases cannot learn to operate them and understand their applications to engineering work. Parts and design of electronic computers are discussed here merely to enable those who have not given this field formal study to become acquainted with a few of the terms used by computer men.

The IBM magnetic drum machine, Type 650. The drum and electronic computer components are housed in two separate cabinets, one with a console. The third unit provides input/output facilities. The storage unit has a capacity of 20,000 words. Available from International Business Machines Corp.

The Alwac III, general purpose, internally programmed, magnetic drum type digital computer. The memory unit has a main storage capacity of 4096 words. Conversion from decimal-to-binary and binary-to-decimal is automatically performed. Available from Logistics Research Inc.

What is an electronic computer

Any computer is a device that helps solve problems involving numbers or parameters. (The latter is merely a quantity to which one can assign arbitrary values.) Thus slide rules, mechanical adding machines,and even the lowly abacus are, by their nature, computers.

Electronic computers are composed of vacuum tubes, condensers, resistors, magnetic cores, etc.; these conventional components are arranged in circuits to enable the machine to read and remember numbers or letters, to add, subtract, multiply, divide, write out the answer, and check to see that the answer is correct. They do this without supervision, but they do not think! Men must do the thinking for them and put the logical directions in some form that is usable in the machine. When given proper instructions, computers can also look up numbers in tables, look at several results and select the correct one, and know when a problem is finished and when to start a new one.

Analogue computers

One type of electronic computer solves problems by analogy. With this machine, the electrical parts are arranged for each problem so that an electrical model of the physical situation is created. These analogue computers, then, merely allow the use of an electrical part as a substitute for its mechanical counterpart in a problem. The electrical parts are operated or varied to produce the desired results, and the operator studies the resultant effects on the physical system. From this, engineers can design the correct mechanical parts with the knowledge that the real-life system has been predicted. The network analyzer, now being used in the gas industry, is an analogue computer.

Other analogue machines that have been developed to handle the many engineering problems that deal with continuous parameters are designed with parts that vary continuously in proportion with the real parameters and simulate them. The more complicated machines will integrate; they permit those problems to be solved that involve laws of nature that can be expressed in terms of integrations.

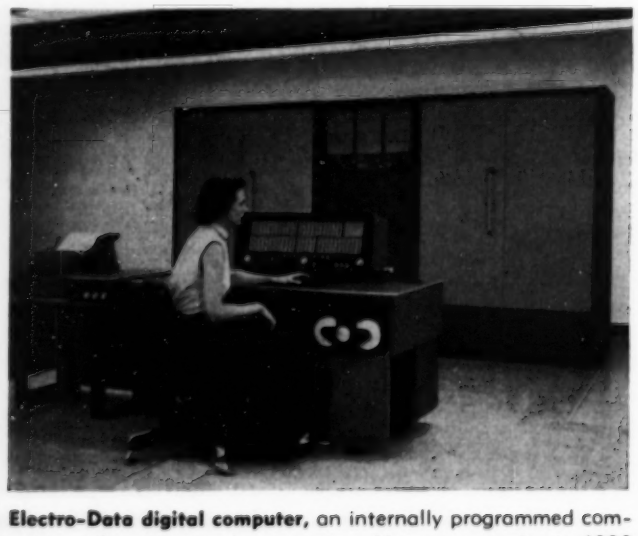
Choice of equipment

Analogue machines can efficiently solve many types of problems that are difficult to solve with other types of electronic computers, but as in most engineering evaluations, the choice of equipment is seldom clear-cut.

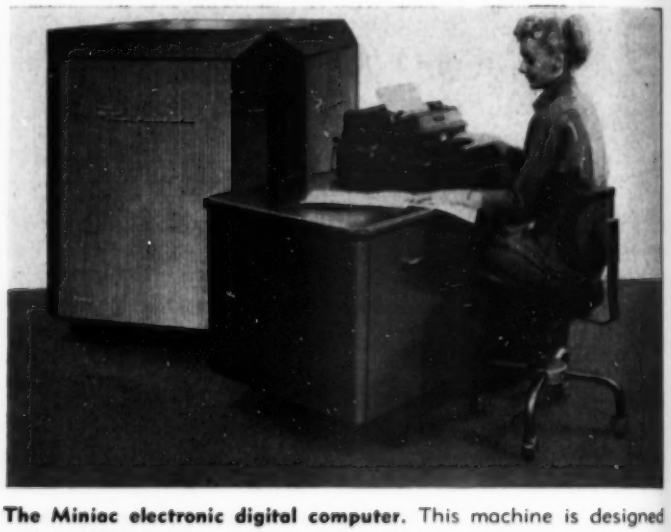
Digital computers

Digital computers are essentially automatic arithmetic machines that count digits and can be made to add, subtract, multiply, and divide. One could probably do the same things on his fingers—these computers just do it much quicker. There seems to be no limit to the different types of problems that can be solved with these machines as long as the user can reduce the problem to mathematics. This is a difficult thing to do, in some cases, but the idea that should be kept in mind is that these machines can be controlled to do basic mathematics in a planned sequence, and can perform their directed tasks at a rate of speed that is 20 or 30 thousand times as fast as that of a person operating a standard mechanical-electrical desk calculator.

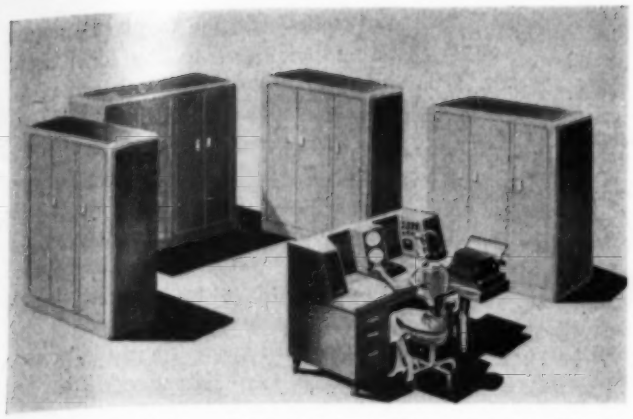
A digital computer cannot think; in fact, the engineer may have to do more thinking in getting his problem into mathematical form than he would have had to do to obtain a solution in the conventional manner, but once the machine has the problem in terms it can use, its speed and accuracy more than offset the time involved by the human in doing its thinking. Computers cannot create new information, but they can transform the information given them into information in a much more usable form. It is important to remember that the basic concept of these machines is that they process data according to sequences and rules specified by a "programmer."



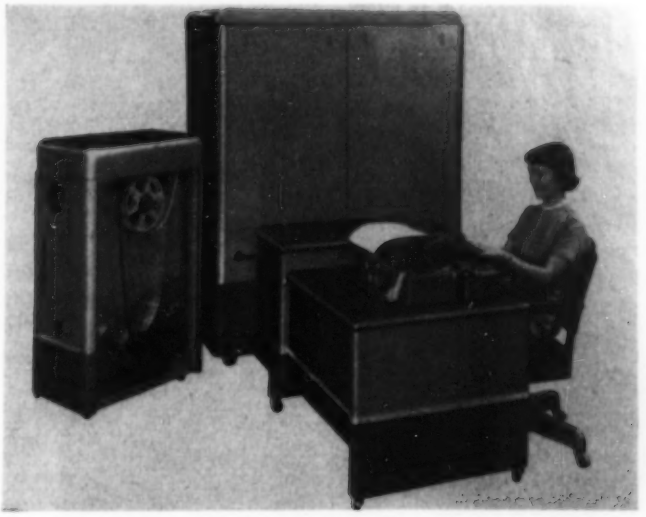
Electro-Data digital computer, an internally programmed computer with magnetic drum storage. Memory capacity is 4000 words of 10 decimal digits and sign, size. Shown in background is the actual computing equipment. Electro-Data Corp. is an affiliate of Consolidated Engineering.



The Miniac electronic digital computer. This machine is designed with a 4096-word capacity magnetic drum storage unit. Drum rotates at 6000 rpm, and input/output units can be Flexowriter, magnetic tape, and punched paper tape, plus punched card input. Available from Marchant Calculators Inc.



The MAC III high-speed, general purpose computer. Electric typewriter, punched cards, or magnetic tape may be used as the input/output media. Memory unit may be electrostatic or magnetic core—with 1024-word capacity. Available from Magnavox Research Laboratories (left).



The National Cash Register Co.'s CRC 102-D data processing system, showing from left to right, magnetic tape unit, computer, Flexowriter, and operator. A magnetic drum memory unit with a 1024-word capacity is used. This machine is available from the Electronics Div., National Cash Register Co. (right).

Components of digital machines

Basically, all digital computers used by industry today have five components —*input, storage, arithmetic, control, and output.*

Many of the newer designs have embellishments on these basic parts and many machines have accessories of a specialized nature, but the basic components carry out the prime concept.

The input, as the name implies, reads the information relative to the problem and its solution from some physical medium and transfers it into the machine. Information to the machines generally used in the gas industry is read into the computer from punched cards, paper tapes, or magnetic tapes. A human must prepare the read-in information.

The storage unit is the so-called "memory" of the mechanism. When one multiplies two five-digit numbers, he generally uses paper and pencil. In this case, the paper is the storage unit because it is used to help him remember the numbers that result from each step in the solution of the problem. Digital computers must have such a unit to aid them in their calculations and to store instructions necessary for the sequential solution of lengthy calculations. In addition, the electronic storage or memory units usually are able to store part of the input data and a substantial part of the output information, or at least until enough of the latter has accumulated to keep the output device working continuously for a reasonable length of time. The other parts of the computer can "call" for stored information for further calculation over and over as directed by the instructions. Each storage location is identified by a number or symbol, which is called an "address."

The arithmetic unit performs all of the mathematical and logical operations. This unit does the high-speed calculating: addition, subtraction, multiplication, division, root extraction, formulae evaluation, algebraic and transcendental equation solution, series summation, differential equation solution, etc., to name just a few. When high-speed calculations are mentioned, it should be understood that 14,000 mathematical operations a second is not unusual. Some of the larger machines work easily this fast, while some of the smaller units have maximum speeds of about 2000 calculations per second. These are just average speeds—there are both faster and slower machines on the market.

Control or program units are designed into computers to coordinate the calculations and route factors so that the machine's units work as a team. It should be pointed out that while a digital computer may consist of a number of units housed in separate cabinets or consoles, these units are linked by flexible cables to form the entire computer. The control unit forces the various components to work as directed.

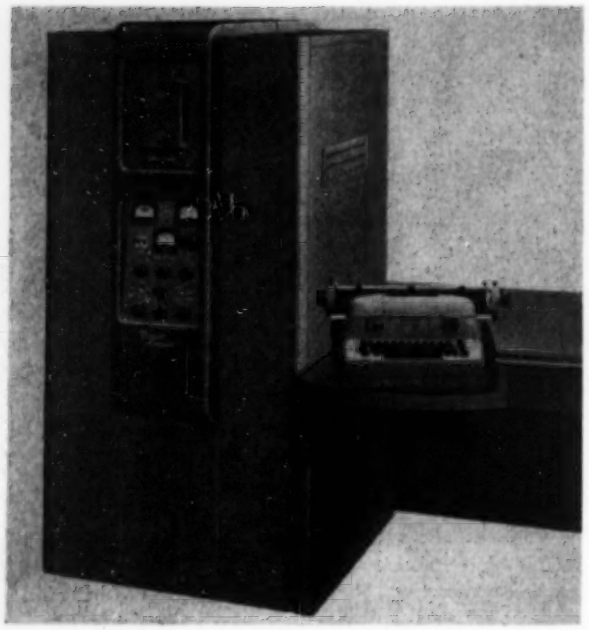
The output units write the answer(s). Various types of these units are available, but generally those used with gas industry computers "read-out" the information in printed form, punched in cards, or punched in or recorded on paper or magnetic tapes.

Machines are available or can be made up from components using as few or as many as desired. There are "Fords" and "Cadillacs" available in the digital computer field. Some of the machines will be discussed in detail later.

Programming

A program details exactly what a computer is to do under every conceivable combination of circumstances. Computer men say that a computer can be programmed or directed to do anything that can be done with pencil and paper. If the method required for the solution can be written down in concise and logical steps, a machine can be programmed to obtain the solution. Thinking could be programmed into a machine and the machine would proceed to think if someone could write down the logical steps in the process of thinking. This again points up the fact that these devices can do nothing that they are not instructed to do.

There are a variety of ways of programming, some of which become rather complex; however, the fixed method of programming and stored programming are the types with which we are concerning ourselves here. Standard washing machines have a fixed program: that is, the sequence of their filling, draining, spinning, etc., is built into the unit so that it goes through the same steps at the same time during each subsequent cycle. If one wished, he could change the wiring to the various control mechanisms and alter the sequence or program. Many electronic digital computers of the fixed program type have their programs set by wiring and circuits designed into them. Some are



The Bendix G-15A general purpose, stored program, all electronic digital computer. Unit has magnetic drum storage with capacity of 2176 words of 29 binary digits size. Available from Bendix Computer Div., Bendix Aviation Corp.

provided with a plug-board so that the fixed program can be altered and some are constructed so that different plug-boards can be used if it is desired to change the fixed program.

Let's suppose for a moment that we should ask a person to carry out a series of calculations using data supplied by us. We might furnish him a separate paper with our instructions on it, or we might tell him what to do and jot down the instructions at the top of the page containing the data. These alternate methods would involve two stored program concepts, the first on a separate paper, and the second on the same medium as the data. Both of these systems are used in stored program digital computers. The first may be illustrated by the machines that use a special program tape; the second is the system used on most modern computers and is what is generally meant by "stored program."

How it is done: First, a few terms should be defined. The word digit implies the use of the decimal system of numbers based on 10; however, binary computers have been designed to use a system of numbers based on two, so computer men tend to use the term "character" as it encompasses both the digit of the decimal system and the "bit" of the binary system. Characters represent one number or letter—two or more characters comprise a "word."

To make a program and execute it, it is necessary for the computer operator to prepare a list of the data and a list of the instructions necessary to process this data arithmetically in a manner that produces the required answer. The data and instructions then must be put into a form compatible with the design of the input mechanism of the computer. Theoretically, the instructions could be written in English, but practically they are changed to a shorthand form of code words (not unlike the "words" used to represent numerical quantities) so that information is condensed as much as possible. This process of translating information into a form usable by a computer is called "coding." Coded instructions and data are then punched into cards or paper tape, recorded on magnetic tape, etc. After all the data and instructions have been coded onto a medium suitable to the machine, actual read-in can begin.

Typically, the operator pushes a start or load button on the computer's panel which reads-in the first two instructions. Then, control may be switched to the first of the instructions, but the read-in operation will send the two instructions to the first two positions of the storage unit. The first instruction would probably be one telling the machine to send the next two instructions from the input device into the third and fourth positions in the storage unit. It can be readily seen that this system can build itself by having each read-in instruction call in two new instructions until the instructions necessary to solve the problem are accumulated. Note that each instruction has an operation part that tells the machine what to do and an address part, which tells it where to send the information within the storage unit. In another instruction, the address part might tell the computer where to go in the memory unit to get a needed word and its operation part might tell the machine to send the word (located by the address part) to the adder or to some other mathematical section. In these examples, the "single address code" has been illustrated, that is, the system in which the instruction always carries the address of a word rather than the word itself. This is advantageous because it allows the words to be changed to suit a particular problem without the stored program being changed.

Some machines currently in production use a "two-address code" that has, as the first address, the location of the word on which operations are to be performed, the second address being used to tell where the next instruction is stored. From this, it is obvious that a three-address code could easily follow—the first two addresses could tell where two words are stored and the third address could tell where to put the results of the operations performed on the two words (if they were added, for instance) for storage. Similarly, a four-address code could be used; in this instance, each instruction might contain two input addresses, one output address, and the address of the next instruction. One could go on from there to develop any number of possibilities. Which one would be best would certainly depend on the situation, and even then would be a matter of dispute.

The foregoing discussion of programming has only given some of the more basic concepts. Actually, programming is an art that is not readily learned without diligent study of previously devised instructions. The programmer does not have to write down every operation that he desires the computer to perform. He can have stored programs that "transfer on zero" or cause the control to be transferred to the instruction stored at a specified address if the result of an operation (addition, division, subtraction, etc.) is zero. Also, transfer operations may be stored to "transfer on plus," "transfer on minus," or "transfer on overflow" when the machine's computations produce a word with more characters than the machine is designed to handle. The programmer may read-in a relatively short program that relies on these stored "sub-programs" to modify and adapt the program as required during the course of the solution of problems.

In the final analysis, the many facets of programming make digital computer operation complicated in spite of the fact that the machines are not relatively complex themselves.

Application of digital computers to the gas industry

The application of digital computers to data processing in the accounting, payroll, record, and billing fields is relatively well known to and within the gas industry. However, the modern trend is toward the use of these machines for the solution of engineering problems so that massive calculations are removed from the hands of the engineer, who is freed to use his time in the more valuable fields of investigation, design, and development.

Eight companies

At the present time, a spot survey of 28 selected gas transmission and distribution companies reveals that at least eight major companies are applying electronic digital computers to some of their engineering problems. Another group of seven is actively planning or studying the application of these machines to problems of this type. Others are using analogue computers for pipeline and distribution network analysis. The eight companies now using digital computers are applying them to the problems shown in *Table 1*.

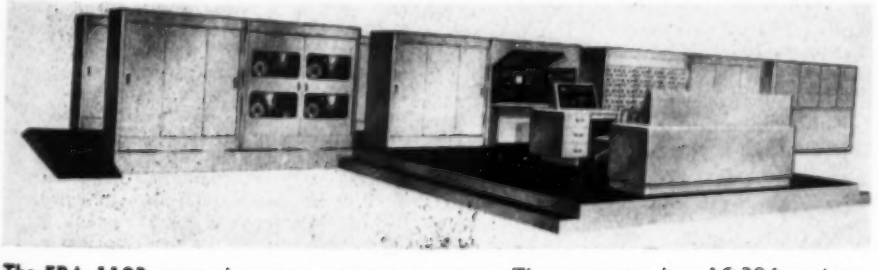
The tasks in *Table 1* actually represent the combined applications for some of the companies now using digital computers; however, no one company has reported using more than six of these applications. This would indicate that some companies may not be using the computers to their fullest potential. It also indicates that there may be some doubt as to the advantage of some of the applications; perhaps there has been a lack of interchange of information about the capabilities of computers and the problems they can be programmed to solve. In any case, the variety of applications is a tribute to the flexibility of the digital computers and the ingenuity of the men who use them. It is known that many, many additional applications are under study at this time and there is no indication of a limit for the development of still others.

Why are gas transmission and distribution companies turning to this advanced method for computation? Simply because rapidly expanding research, production, construction, transmission, and distribution of gas and its facilities are furnishing more and more of the nation's basic energy, and thereby has been created the demand for better and faster answers to more and larger problems through methods of solution that require the use of advanced mathematical techniques often requiring the processing of huge quantities of data. With electronic digital computers, problems are being solved today that would have been physically impossible for one gas engineer (and in some cases, for a small group of gas engineers) to solve in one lifetime using the methods common just a few years ago. Further, electronic computers solve many problems with less effort and expense while producing greater speed and accuracy than before.

Techniques

Strangely enough, utilization by the gas industry of this modern engineering tool does not generally embrace new mathematical techniques. Advanced math, yes; but to date their major applications have been the high-speed use of the same formulae that were used in "hand" computations. This method does, however, enable the engineer to work with much larger segments of a problem or system where it used to be the common practice to break these into small components and reach a general solution by repetitious solutions of the fragments. Some gas network problems are so complex that thousands or even millions of individual calculations have to be made before a general solution can be produced. It is obvious that such problems are not solved using electromechanical desk-type calculators or pencils. An electronic digital computer turning out mathematical computations at the rate of 14,000 operations a second is obviously better adapted for this work.

Aside from the speed, there is another reason of major importance that



The ERA 1103 general purpose computer system. The computer has 16,384 registers of magnetic drum and 1024 registers of electrostatic storage. The input/output section will accommodate a wide option of terminal equipment. Available from Engineering Research Associates Div. of Remington Rand Inc.

TABLE 1.

(1) Pipeline design — this includes pipe size, volume rate of flow, pressure drops, line pack, wall thickness of pipe, maximum allowable internal pressure, sea level horsepower, actual horsepower, elevation between points, specific gravity of the gas, flow temperature, and all variables in general that enter into transmission lines. Economic as well as engineering analyses are being made.

(2) Gas distribution network analysis by use of the Hardy-Cross and other methods.

(3) Pipeline dispatching.

(4) Compressor station design.

(5) Compressor design (i.e., fuel consumption, capacity, and developed horsepower of reciprocating compressor cylinders).

(6) Line loss balance statement calculations.

(7) Solution of the orifice equation in gas measurement.

(8) Numerical integration of engine indicator charts.

(9) Reduction of civil engineering survey notes.

(10) Cathodic protection current requirements.

(11) Equilibrium flash calculations.

(12) Mass spectrometer data reduction.

(13) Well stream recombination calculations from field, distillation, and mass spectrometer data.

(14) Computation of gravity factors for geophysical personnel.

(15) In-place gas reserves calculations.

(16) Calculations of produced, purchased and delivered volumes of gas.

(17) Calculation of quantities in gas mixing problems.

(18) Proration of the allowable gas production back to individual wells.

(19) Research mathematics.

(20) Reservoir analysis.

has influenced gas companies to use these machines in engineering work. That is the improvement in accuracy. Digital computers have not completely eliminated the human equation, for we must remember that the machine depends on people both to tell it what to do and to prepare the proper data in a form compatible with the machine's design. However, stored checking programs usually reveal errors. The machine is, of course, subject to the breakdowns associated with any mechanical device, but an operator can usually scan results and detect them. When digital computers make errors, they are usually of a magnitude that makes them very obvious. Actually, machine errors are extremely few, especially when compared with conventional calculators which depend much more on the human element. If a fairly large digital computer should produce one error during eight hours of continuous operation, this would be one error in more than a million computations—less than one per lifetime for a person making the same number of computations with pencil and paper.

Computer experience of a gas transmission company

Supervisory engineers of one large natural gas transmission company felt that pipeline design problems were taking too much of their engineers' time. This work was being done with slide rules, log-tables, estimating curves, and standard desk calculators. The design problems involved with the solution of gas flow and compressor relationship problems were particularly vexing because even a small change in gas requirements necessitated a recomputing of the complete system in order to determine the effect of that change upon system operation. A problem of this nature might require as much as three weeks of an engineer's time. On large-scale projects, five engineers might devote much of their time to various tasks, many of which were routine mathematical computations. They decided to apply digital computers to this type of work to reduce the time required and to free engineers for creative thinking.

This pipeline company ordered a computer in October 1952; then, some months later, a mathematician was employed to supervise the use of the machine. This allowed the technician about six months to study gas transmission operations and to become familiar with some of the engineering problems that would be encountered. The machine, an IBM Model II card-programmed calculator, was installed and ready for operation by October 1953.

The Burroughs E101 electronic digital computer. This computer has a magnetic drum storage unit with a capacity of 100 words of 12 digits each. Input/output are by the Burroughs keyboard and flexible semi-ganged printer. Novel pinboards provide accessible program steps. Available from Computer Section, Special Machines Dept., Burroughs Research Center.

At this time, the personnel assigned to the computer include the supervisor, one mathematician, one computer operator, and one card punch operator. The computer has four units, a standard electronic calculator, an accounting machine for interpreting instructions and for accumulating and printing results, a storage unit for retaining data for later use in a problem, and a punching unit for recording results in punched cards. Numerical instructions in punched cards command the sequence of operations. These instructions direct the electronic calculator where to obtain factors; whether to add, subtract, multiply or divide; what to do with the results—print them, punch them, hold them for later use, or perform combinations of these operations.

Pipeline design

The major application is to economic and engineering analysis of pipeline design. The company has its four major transmission systems set up on IBM cards so a particular section of a line

SAMPLE PROBLEM: Code and program $ax^2 + b$

A digital computer with 400 storage locations will be used. Addresses for storage or memory locations will begin with 000 and progress sequentially—001, 002, 003, etc.—for the 400 specific addresses.

The machine has a capacity of five decimal digits. For instruction words, the first two (lefthand 2) digits will be the operation part and the last three digits will be the address part. The following operation code will be used:

Clear and add	01
Add	02
Subtract	03
Multiply	04
Store	05
Stop	00

Thus, an instruction word 02021 means "add the word found in address or location number 021." For simplicity, it will be assumed that a = 100; b = 200; and x = 300. These numbers will be stored at locations 006, 007, and 008, respectively. The answer will be stored in memory location or address 009, for later use.

Address	Data
006	a = 100
007	b = 200
008	x = 300

The Program

Memory Location	Instructions and Data	
000	01006	Instruction words
001	04008	
002	04008	
003	02007	
004	05009	
005	00000	
006	00100	Data words (actual members)
007	00200	
008	00300	

A stored program computer is being used, so all of the program is read-in to the memory unit as the first step. Instruction word 01006 will be stored at address 000, 04008 will be stored at 001, 04008 will also be stored at address 002, instruction 02007 will be stored at 003, and so on until all of the instructions and data have been read-in and stored at respective addresses.

Then, the engineer pushes the start button—the machine automatically goes to address 000 and finds word 01006 there. This means "clear the machine and add that data found at address 006." The control unit pulls 00100 from memory location 006, sends it to the arithmetic unit, and causes the arithmetic unit to clear out any previous problem and add 100. So "a" is in the arithmetic unit. Next, the machine goes (in sequence) to the instruction at address 001 and learns from the coded instruction word there that the uncoded number or word stored at address 008 should be sent to the arithmetic unit and multiplied. The control unit executes this command; "ax" is produced in the arithmetic unit. Instruction at 002 sends the machine to address 008 again and "x" or 00300 is multiplied again in the arithmetic unit; "ax^2" is produced. Word at 003 sends "b" or 00200 to the arithmetic unit, and instructs that it be added; "$ax^2 + b$" results. Instruction word at 004 sends the answer to address 009 for storage, as it is desired that this answer be available for later use. Instruction in 005 stops the sequence of instructions and the computations. Note that this step neatly separates the instruction code words from the data.

or a whole line, can be taken from the files and readily worked. The effect of small changes in gas requirements on one of the mainlines can be computed in two or three hours, as compared with about 120 hours with conventional methods. Even where major changes are contemplated, the computations seldom take longer than five hours. These computations can be accomplished to show the quantity and size of pipe, and where it is required. Additional horsepower, and where it will be required, can also be obtained as can any of the variables associated with gas flow and the design of the pipeline to transmit it. An economic analysis is computed simultaneously with the other design factors. These are average cost figures suitable for preliminary engineering-economic study. The flexibility of this system is actually quite remarkable.

Granted, to set the lines up on punched cards took some time and study, but once the original investment in time was made, the cards were set up for instant use for years to come. All necessary data are at hand; such variables as volume, pipe diameter, length, pressures, wall thickness, gas specific gravity, elevation, sea level and actual operating horsepower, loads, etc., are all on the cards. Change one of the variables, and in several hours the computer will give the effect of this change at both ends of the line and at any selected points in between, and an approximate cost of making the change is printed with the desired engineering results.

This program has changed the entire philosophy of pipeline design for this company. Previously, if changes in flow volumes were necessary, the time required to evaluate the effects made it practical to work out only a minimum number of designs—perhaps two or three—for submission to management. With the digital computer, 20 or more designs can be worked out in the same time period—not that this number would actually be required, but the engineers can try many different designs before selecting the several more advantageous methods to present to management. The importance of this is difficult to evaluate in dollars and cents; however, it is obvious that the value of this feature is much greater than the mere fact that man-hours are saved.

As an illustration of another advantage of the computer operations, the chief engineer recently received a call from one of the company officials in a distant city. The official was in the pro-

GLOSSARY OF TERMS

Access Time: That time required to call a number from storage and make it available to the arithmetic section.

Accumulator: A device which is capable of addition and subtraction. This is usually found in the arithmetic section.

Address: A symbol, numerical or alphabetic, designating the storage location of one number or word.

Analogue Computer: A computer in which numbers are represented by physical magnitudes, such as the amount of rotation of a shaft or a quantity of electrical voltage or current (see digital computer). Nomographs or charts which represent quantities of lengths of lines on a sheet of paper are of the analogue type.

Arithmetic Operations: Addition, subtraction, multiplication, and division.

Arithmetic Unit: That part of the machine in which the arithmetic operations are performed.

Binary Coded Decimal: A system of representing decimal numbers in which each decimal digit is represented by a combination of four binary digits. For example, the IBM Type 604 electronic calculator uses this type of representation.

Binary Digit, Bit: General name for either of symbols in binary system.

Binary Number System: A number system using the base two. There are only two symbols: one or zero ("on" or "off"). Digit values reading from *right* to *left* are: 1, 2, 4, 8, 16, 32, etc.

Bucket: A slang expression for that part of a storage device which stores one number or word of information.

Cathode Ray Tube (electrostatic storage tube): An electronic tube, something like a television picture tube, used for storing information in some machines.

Control: The section of a data processing machine which controls all operations of the machine. It may be compared with a fully automatic telephone exchange.

Data Processing Machines: A general name for machines which can store and process numerical and alphabetic information (see analogue and digital computer).

Decimal Number System: The common number system using the base *ten* and having ten symbols which are: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Column unit values reading from *right* to *left* are: 1, 10, 100, 1000, etc.

Digital Computer: A computer to process data consisting of clearly defined numbers as opposed to physical quantities processed in an analogue computer (see analogue computer).

Diode, Crystal Diode, Crystal Rectifier, Germanium Diode: An electric element used in computing machine construction which will pass current in one direction only. Similar in operation to "filters" found on standard IBM Accounting Machine control panels.

Erase: To destroy the information stored on the surface of a magnetic tape, magnetic drum, or cathode ray tube in order to make this storage space available for storage of new information.

Input: Information (instructions or data) delivered to the machine.

Instruction: An order to the machine to perform some operation. The instruction usually contains also the storage address of one or more numbers which are to be used in the operation.

Magnetic Drum: A rotating cylinder surfaced with a material which can be magnetized. This is used to store information. Information is stored by the presence or absence of magnetized spots on the drum surface.

Magnetic Tape: A flat ribbon of metal, plastic, or paper which is coated on one side with a material which can be magnetized. Information is stored on the tape by a combination of magnetized spots in certain patterns.

Millisecond: One-thousandth of a second.

Microsecond: One-millionth of a second.

Output: Information produced by a machine.

Output Device: Part of a machine which translates the intangible electrical impulses processed by the machine into tangible permanent results: (1) printed form, (2) punched cards or tapes, (3) magnetic "writing" on magnetic tape.

Parallel Operation: The type of operation within the arithmetic section of a machine so that all digits of a number are handled simultaneously. For example, the usual desk adding machine has a parallel type of operation.

Permanent Storage: The medium used to retain intermediate or final results outside of the machine (see output device). This is usually in the form of punched cards, punched paper tape, or magnetic tape.

Printer, Line Printer, Single Stroke Printer: Unit of the machine which prints the results obtained from processing some data. Numbers, letters, or symbols may be printed, depending on the device. A line printer records one line of symbols simultaneously, as, for example, an IBM Type 402 or 407 accounting machine. A single-stroke printer records one symbol at a time, as, for example, an IBM electric typewriter.

Read, Read In, Read Out: The operation of transferring information from one type or location to another type or location. For example, punched cards or magnetic tapes may be read and the information they contain may be transferred to other storage locations within a machine.

Serial Operation: The type of operation within the arithmetic section of a machine so that a number is handled one digit at a time (see parallel operation).

Sign, Sign Digit: The symbol or symbols which distinguish positive (+) numbers from negative (—) numbers for a machine.

Single-address Instruction: An instruction which usually contains one operation and the address (location) of one number on which the operation is to be performed (see three-address instruction).

Storage: A general term for either the ability to hold or the equipment for holding information.

Stored Program: A characteristic of certain machines whereby instructions in the form of numbers, letters, or symbols are held within the machine. The machine refers to these instructions in a specified sequence and performs the operations specified by the instructions.

Three-address Instruction: An instruction which contains three addresses and one operation. A machine will call two numbers from the first two addresses (locations), perform the required operation, and store the results in the third address.

Write: The operation of storing a number on the surface of a magnetic tape, a magnetic drum, or a cathode ray tube.

This glossary has been taken from IBM's booklet entitled "Light on the Future."

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"In all the Republic Line Pipe we've insta
so far, not a single joint has been out of ro
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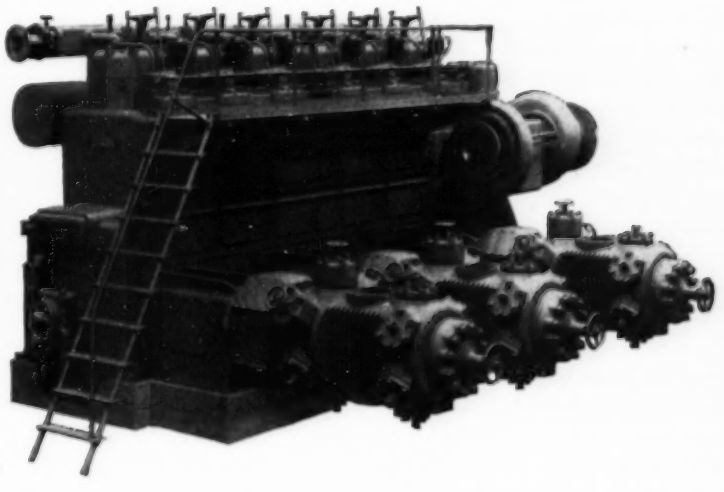


Clark sets the pace in compressor progress

cess of conducting some business that would affect the operation of one of the main pipelines. The engineer was asked what the effect would be if a proposed change to the line was carried out. First, the punched cards for that line were pulled from their storage space. Then, cards were coded and punched to reflect the proposed change. Since a program for directing the computer in the solution of this standard problem had been used time and time again, it was necessary merely to feed the cards through the units and observe the neatly printed answers that were produced in very little time. The answers reflected that a certain length of a particular size of pipe would need to be incorporated into the line, along with a definite number of horsepower, to accomplish the proposed change. The preliminary cost figures (accurate enough for estimating) were printed with the physical data. In less than four hours, the official knew the answer to his specific problem and was able to base his negotiations on it.

The pipeline company's design engineer does not feel that the addition of a digital computer has reduced his personnel requirements. In fact, he is quick to point out that these devices will require more men on the staff; however, this is more than offset by the resultant efficiency of design and increased investigative ability. His staff can create and operate while the computer performs the necessary laborious calculations. In his words, the use means as much or more than the speed.

Other applications

Following the initial success of the computer's application to pipeline design work, this company started using it for other engineering problems. The usual procedure was for the supervisor to study the proposed application for two or three weeks to learn the process and do research into the mathematics involved, so that he could direct the coding and programming of the problem. For six or eight months after the installation of the machine, an engineer experienced in the field from which the problem originated would spend time with the computer men and make the engineering decisions affecting the progress of the problem. Now, the computer personnel have developed the pipeliners' instinct and can usually proceed on their own. They maintain communication and cooperate with the engineers, so that the operations of the computer are tied in with the company's operating policies.

One of the applications is in the field of hydrocarbon process calculations. Known variables are the analysis of the feed gas and equilibrium constants for various temperatures and pressures. The computer is used to determine the liquid-vapor ratio. Experience indicates that a problem of this sort takes about 10 minutes on the electronic machine. By hand, a person has done well if he can produce an accurate solution in four hours.

Other current applications being handled by the CPC machine for this company are:

1. Pipeline dispatching.
2. Compressor design.
3. Numerical integration of engine indicator charts.
4. Reduction of civil engineering notes.

A company engineer is currently working on an application for the determination of plate conditions for optimum recovery of components from feed stocks before passing them through fractionating towers. Several other applications are also being investigated.

Summary

The machine is assigned to the design section of the home office engineering department.

The engineers have found that coding and programming take much more time than the actual computations on new problems; however, most of the programming time goes into the solution of problems that will be of a recurring nature, so each of the problems following the same basic program for solution shares in the cost of the programming. Problems can be solved for years using the basic components of a previously prepared program, so the cost becomes very small from the long-range view. It is estimated that each instruction costs about $4 as delivered to the computer. Some problems require as many as 400 program cards, but the average used by this company is about 100 programs per problem.

Computer experience of a distribution company

The prime use of digital computers made by distribution companies has been in the solution of network analysis using the Hardy-Cross, or other methods, for solving a system of simultaneous, non-linear equations. One company made a detailed study of the time required to work one of these network problems by designing a hypothetical distribution system so that the paper and pencil solution to check the accuracy of the machine would be much easier.

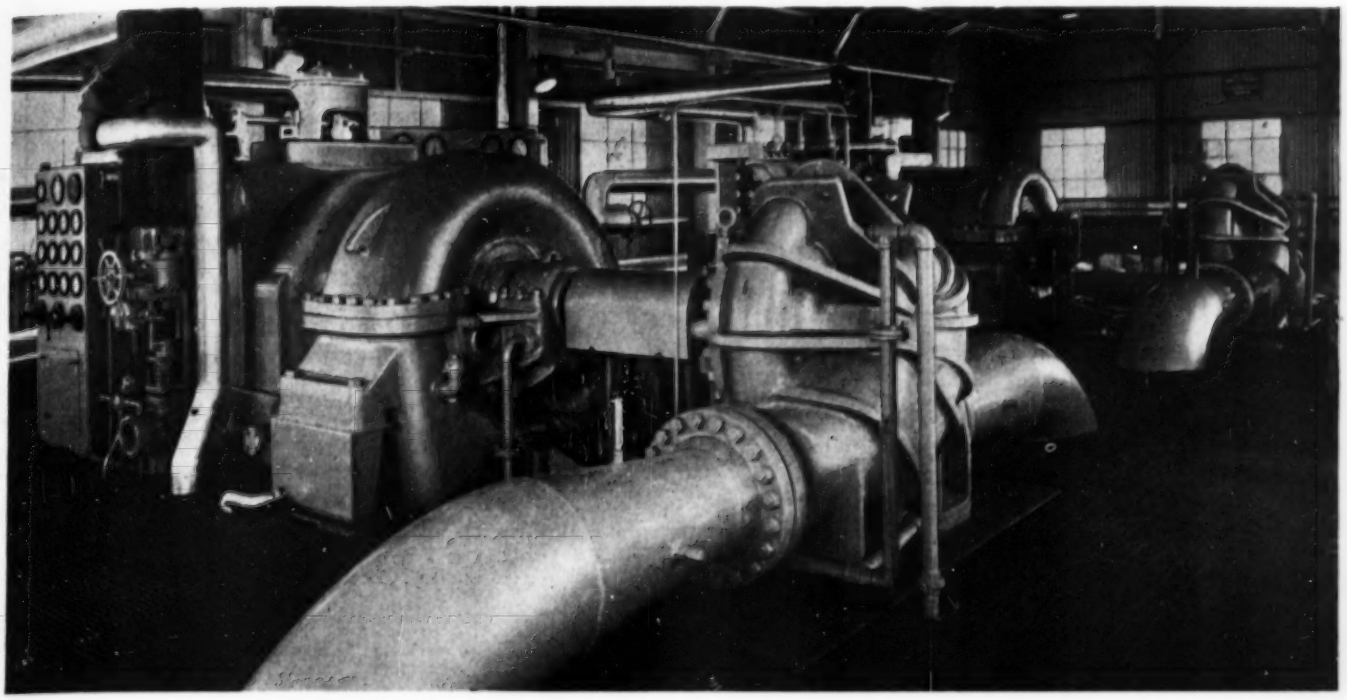
This problem involved 14 loop lines being fed from twin feeds, each of which had a different inlet pressure. Twenty-five separate loads were taken from the system; a geometrical physical layout was assumed, and the various pipe lengths, internal diameters, inlet pressures, and volumes to be delivered at load points were known or given. The digital computer was programmed to solve for the pressures at the load points. As any distribution engineers knows, a problem such as this represents three or four weeks work for one engineer using conventional methods. At that, certain additional assumptions have to be made that need not be made when a digital computer is used.

The mathematician selected to apply this problem to a digital computer did considerable research into the mathematics of the Hardy-Cross method and finally evolved his own method of solving simultaneous non-linear equations. This research, and the coding and programming, took about 300 man-hours, but it should be remembered that this basic investment in time is useful for years, and the methods developed and the basic programming can be used over and over again.

This problem took about one-half hour to read in to the computer, the digital machine made the calculations in about 12 to 14 minutes, and about one-half hour was required to read out the answer. The answer produced was checked, and it was concluded that the accuracy was far greater than is usually produced by conventional "hand" methods. It is interesting to note that a mathematician worked for about two weeks just checking several of the loops to assure himself that the computer was accurate and measure the degree of accuracy.

Other applications made by distribution companies have been listed previously in this article. Some distribution companies are continuing to develop new applications. It should be obvious that there is a vast potential for forecasting load growth, areas of greatest return with the least investment, send-out requirements in relation to weather, weather itself, and many other tangible variables in distribution system operation and development. ■

"Packaged" Compressor Plant for gas pipeline compressing

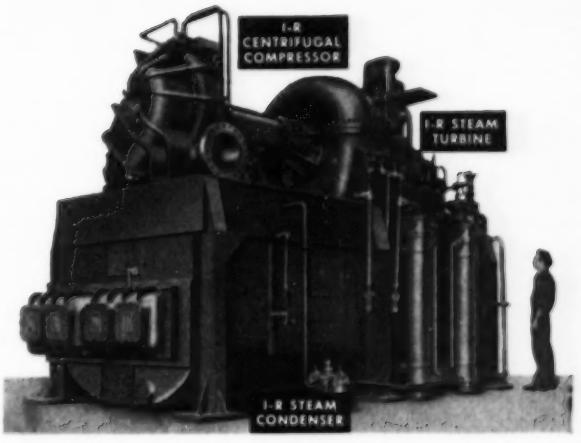


Steam Turbine-Driven Centrifugals provide important savings in installation and operation

Here's the latest development in gas pipeline compressing—a completely self contained Ingersoll-Rand "packaged unit" consisting of a steam turbine centrifugal compressor and a surface-type steam condenser with special structural steel bracing to provide a foundation for both turbine and blower. The arrangement permits substantial savings in foundation costs and in the time and expense required for installation.

All components, including the condensate pumps and ejectors, are performance matched for highest efficiency and minimum maintenance.

If you're thinking in terms of a new centrifugal compressor installation, you'll want to investigate this I-R "packaged unit." Call your nearest Ingersoll-Rand engineer for complete information. He can help you select the best compressor—centrifugal or reciprocating—for your particular requirements.



In the installation pictured here, three of these "packaged units" are arranged in series to handle 465 million cubic feet of gas per day and boost the pressure from station intake of 470 psig to full line pressure of 800 psig. The 4370 hp turbines drive the centrifugals at 4700 rpm.

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Will gas companies intensify exploration activities?

Some leading transmission companies believe the fair field value formula together with the Phillips decision would tend to encourage exploration and development programs; others aren't so sure, a recent GAS magazine survey shows.

By **WILLIAM W. CLARK** · Editorial Director

NATURAL gas transmission company executives are in accord with the proposition that the extension of federal regulation to the wellhead is unfortunate, but what effects it will have in the gas industry either in the immediate future or in the long pull are subjects about which considerable differences of opinion exist.

Based on the results of a recent GAS survey among leading gas transmission companies that produce a share of the gas they transmit, it would appear that the industry is moving into 1955 equipped with a crystal ball that is rather heavily clouded. None of the respondents was willing to say that his company was going to rush into new exploratory programs as a result of the Phillips decision and FPC Order 174-A. Some thought the meshing of the fair field value formula with the Phillips decision would tend to encourage transmission companies to redouble their explorations and developmental programs; others were not so sure. It was generally agreed that the Phillips decision would not encourage transmission companies and distributing companies to expand their facilities, but there was some difference of opinion as to whether it would actually discourage this growth.

Gas companies are generally trending toward producing more of their own gas supplies, but at a fairly modest rate; and this trend began long before the Supreme Court issued its epochal decision in the Phillips case. There is some feeling that this decision, coupled with the fair field value formula, will accelerate the trend. Most companies, all other things being equal, would rather be able to operate independent of outside sources of supply. But until the fair field value formula was clearly set forth in the Panhandle case, the returns on production investment were so depressed that there was little incentive to drill for their own reserves. Dusters never got into the rate base; and with the rate base formula pretty well held sway until the commission decided the Panhandle case.

With a surprising suddenness, transmission companies that produce their own gas and independent producers are finding themselves in somewhat the same boat. Producers will not be obliged to devalue their gas to zero or a minus "value" as gas transmission companies have been forced to do in the past to keep rate-based earnings under the commission's arbitrary ceiling; FPC has, in fact, tried to give them assurance that it will recognize that the gas has a commodity value in itself.

Would the combination of fair field value formula and the discouragement of producers by the FPC order tend to spur integration of the industry? Transmission company executives tentatively feel that it might. Whether this would actually work to the advantage of the gas industry is another question. For the most part they need more "experience" on which to base their opinions of this proposition.

Upward pressures on field prices over the past decade or so have sent some companies out into the fields in search of their own supplies. Then, too, the reticence of producers to sell their gas for interstate transmission was not born of the Phillips decision; it was merely given a great deal of emphasis thereby. Producers have long feared the extension of federal controls to their properties, as the writing in of escape clauses in gas purchase contracts so clearly attests. Even the FPC's own assurances in the past, coupled with the commission's decision in the Phillips docket (wherein Phillips was adjusted to be not a "natural gas company," an opinion that was overthrown by the courts in 1954), were not sufficient to allay the producer's doubts. The ill-fated Kerr and Moore-Rizley bills were products of these doubts; their failure must have been even more disturbing.

Well aware of these events, transmission companies have kept a watchful eye on supply probabilities and potentialities. The thought that the courts might make their move toward bringing wells within federal jurisdiction and thereby automatically give effect to escape clauses must have been discomforting, even though it has been pointed out by some transmission companies that such clauses are worthless. A natural gas company cannot abandon service, it is argued; and producers did not become natural gas companies by virtue of Order 174-A. The court has said that they were already. But, here again doubts must have existed.

One company recites its experiences in extending its operations from distributing and transmitting gas back to the production phase of the business. Prices started bouncing along about 1945. Oil companies from whom they were purchasing gas began to be worried about the possibility of the extension of FPC jurisdiction. Casing short-

PACKAGED COMPRESSOR *SPEEDS* PENETRATION RATES ON TEST WELLS

OIL INDUSTRY TECHNOLOGISTS, investigating methods of reducing present-day drilling costs, recently started a series of tests using aerated mud. Of major importance to this program was the selection of a compressor. The unit had to deliver, automatically, full rated capacity over a wide range of pressures — to operate virtually unattended, leaving the crew free for regular duties. When moving it was essential that only oil field equipment be used and no special foundation required at the drilling site.

A Beaird-Ingersoll-Rand 4-Cycle Packaged Compressor Plant, 220 horsepower 8 JVG, was purchased by Phillips Petroleum Company for this task. Beaird engineers installed automatic controls that permit it to slow down or pick up speed over a range of 50% to 100% according to discharge conditions. A stop valve on the rig floor is all that is required to shut off air instantly for a connection or a trip. Other automatic controls safely handle this sudden change in operation — slowing the engine and unloading the compressor cylinders.

Mounted on its own heavy steel skid base, the compressor is set in a shallow pit near the rig and ballasted with sand or caliche. It moves as a single over-the-road package between drilling sites. On the new location only connections to fuel and mud lines are required to place it into operation.

Let us show you how a Beaird-Ingersoll-Rand packaged compressor plant can be designed to meet your requirements. Sizes 110 h.p. to 660 h.

▲ Beaird-Ingersoll-Rand 220 h.p. 8 JVG four-cycle gas engine driven compressor equipped with Young radiator and all necessary equipment and controls on Phillips Petroleum Company's drilling rig.

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LP-GAS SYSTEMS

Exploration activities ... The FPC could develop new pricing formulae

age was also a problem for producers along about the time the Korean war was in full swing. Productivity in the fields from which the utility was receiving gas began to decline. So the utility took assignments of substantial blocks of acreage from major oil companies who farmed out dry gas rights only. Drilling in 1954 by the utility totalled 35 wells, and 1955 shapes up about the same.

This company, incidentally, is not too worried about the long-range effects of the Phillips decision.

Says the vice president of this company:

> "We don't view the Phillips decision as anything more than a temporary road block in the way of expanding the natural gas business. A lot of the expansion will take place because transmission and distribution companies have no alternative except to provide additional quantities of gas desired in their existing service areas. They will also desire to conduct a normal expansion of service areas and some means will be found whereby the necessary additional supplies of gas can be secured before this expansion. It is my feeling that this will turn out to be more costly to gas consumers in the long run because of the Phillips decision, though, of course, the obvious implication for any gas presently under contract is that is may through the course of time be no more expensive and possibly somewhat cheaper. The major supplies of gas, I feel, will continue to be found by oil companies in their exploration for oil, but these new supplies will be disposed of by the oil companies in some way still to be discovered which will be beyond the jurisdiction of the commission, and which will probably require transmission companies to secure large additional capital sums."

In 1953, this company produced 18% of its own gas, and in 1954 this percentage was a bit higher. The company does not prospect for gas in the sense that "prospecting" means "wildcatting." It will engage in developmental drilling inside the proven limits of a field or attempt to extend a field, and will "occasionally join with others in drilling a wildcat in a proven gas producing area within reach of our pipelines."

Until the cost of gas "began moving rapidly upward, it was our preference to purchase gas rather than to engage in production of it."

In conclusion, this company feels that the Phillips decision will result in increased costs to the consumer, "as have a number of the actions of the FPC which have already been taken—for instance, the requirement of 20 years of physical deliverability."

Attributing a commodity value to natural gas produced by "natural gas companies" will not cost the consumer more, in the long run: that's the consensus turned up in the survey. Opinions range from a feeling that it may cost the consumer more at the outset to flat statements that it will cost him less in the long run. In the latter group, one executive says:

> "It is our belief that the 'fair field value' principle applied to pipeline companies will cost the consumer less in the long run. Until 1946 our total supply was furnished 100% from our presently owned reserves, but with the increase in consumer demand we have been forced to look to other sources for additional supplies. Our proportion of owned reserves to total gas supply has steadily decreased and it has been necessary to contract for additional supplies to meet market growth. At the beginning of 1952 we owned 71% of our total gas supply; at the beginning of 1953, 65%; and at the beginning of 1954, 57%. Thus, we have been increasingly dependent upon purchased gas. As our dependence on purchased gas has increased over the past eight years, so also has the price we have been compelled to pay for such gas. Our purchases in one field in 1947 were made at a price of approximately 6 cents per thousand cubic feet. Currently we find it necessary to pay 15 cents per thousand cubic feet for new gas in any substantial quantity. So in seven years the price of our purchased gas has increased 150%. The 'commodity value' of our own gas which we have included in our last rate application was approximately 9.2 cents.
>
> "Under the rate base method producers cannot afford to explore for and develop gas. It has, in effect, hindered and discouraged exploration and development and therefore hinders the future gas supply in the industry. The statements made by the Federal Power Commission in the Panhandle decision is proof of this. Theoretically, under the 'rate base' method, it may be argued that the producer is permitted to recover unproductive exploration and drilling costs through charges to its customers. As a practical matter this is not so. Rate base is allowed on productive wells only. The cost of dry holes which are drilled by a producer in searching for gas is not allowed as rate base. This is also true of unproductive geological and other substantial exploration costs. Only those exploration costs which occur and which are allowed during a limited test period in setting rates are allowed the producer for rate-making purposes."

Did the Phillips decision, coupled with the Panhandle decision, obviate the necessity of "spinning off" producing operations? Since producing affiliates were not regulated as pipeline companies, it would seem so; and there was some agreement on this point. However, it was pointed out that there may be "some substantial advantages in operating as an integrated company from an income tax standpoint; i.e., accrued taxes on earnings may be more constructively used in exploring and developing on an integrated basis. This is illustrated in the merger of Mississippi River Fuel and its subsidiary, and Tennessee Gas with its subsidiary, Tennessee Production Co."

• • •

As is obvious from the statements of gas company executives, the situation is in need of clarification—and that will only be supplied by operational experience and the outcome of deliberations now going on within the chambers of FPC itself. The commission could conceivably develop new pricing formulae that would be attractive to producers; commodity value, based on average field prices, would perhaps suffice in some cases. But, understandably, producers would prefer to operate outside the regulatory realm, it generally being agreed that money isn't quite everything. A new Kerr bill will most surely be introduced, but it's difficult to see how it could have any better chance of passing than the old ones did;* if anything, more constituents are cognizant of natural gas regulatory problems than they were before, and thus more susceptible to the half-truths dished up by professional anti-natural gas politicians and leftwing journalists.

All in all, gasmen appear to be singing a noncommital tune. Gas sources will not dry up tomorrow, nor will all gas companies have to go out and start digging for their own; and the present regulatory muddle will straighten itself out in time. Just how and when is another matter. ■

*Our Washington editor disagrees (see page 74).

George L. Chapman, Wolverine attendant at Hammond, Indiana, transmits pipeline operations data to New York over a Bell System teletypewriter circuit

"Bell System furnishes us dependable communications at a price we can't equal"

—says Cyrus S. Gentry, President of the Wolverine Pipe Line Co.

Flexible, low-cost communications is what Wolverine Pipe Line Company is getting by renting private line teletypewriter service from the Bell System.

From Hammond, Indiana, products are started along the 295 miles of 16-inch pipe line to Detroit and Toledo. By using a Bell System teletypewriter circuit the operator starts or stops the big high-pressure pump at Vicksburg, 125 miles away.

Hundreds of miles east in New York, a dispatcher keeps round-the-clock watch over the Wolverine Pipe Line's seven stations. He gets reports and sends orders over Bell System teletypewriters.

"The expense of a privately owned system would be far in excess of a rented circuit," says a Wolverine official.

To find out how your communications efficiency could be improved, and costs lowered by using Bell System service, ask your Bell Telephone representative.

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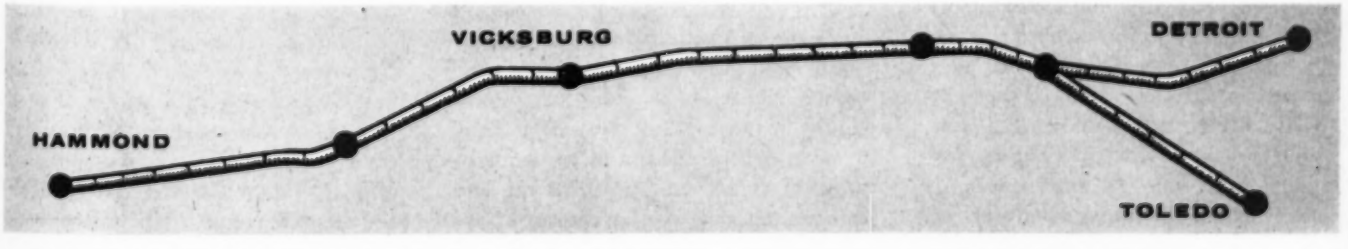


The days have passed when the assistance of commercial banks was needed to provide capital that was largely denied by security financing sources, but the industry still leans heavily upon them for important short-term loans.

The role of commercial banks in gas industry financing

By KENNEDY BUELL, Second Vice President
Chase National Bank of the City of New York

NO one who has had any contact with the gas industry can help but be impressed with the tremendous strides that have been made by this great enterprise. In the short span of a quarter-century it has taken one of nature's major resources, which was then largely being wasted, and converted it into an instrument for better living. In this process enormous problems both technical and financial, had to be surmounted.

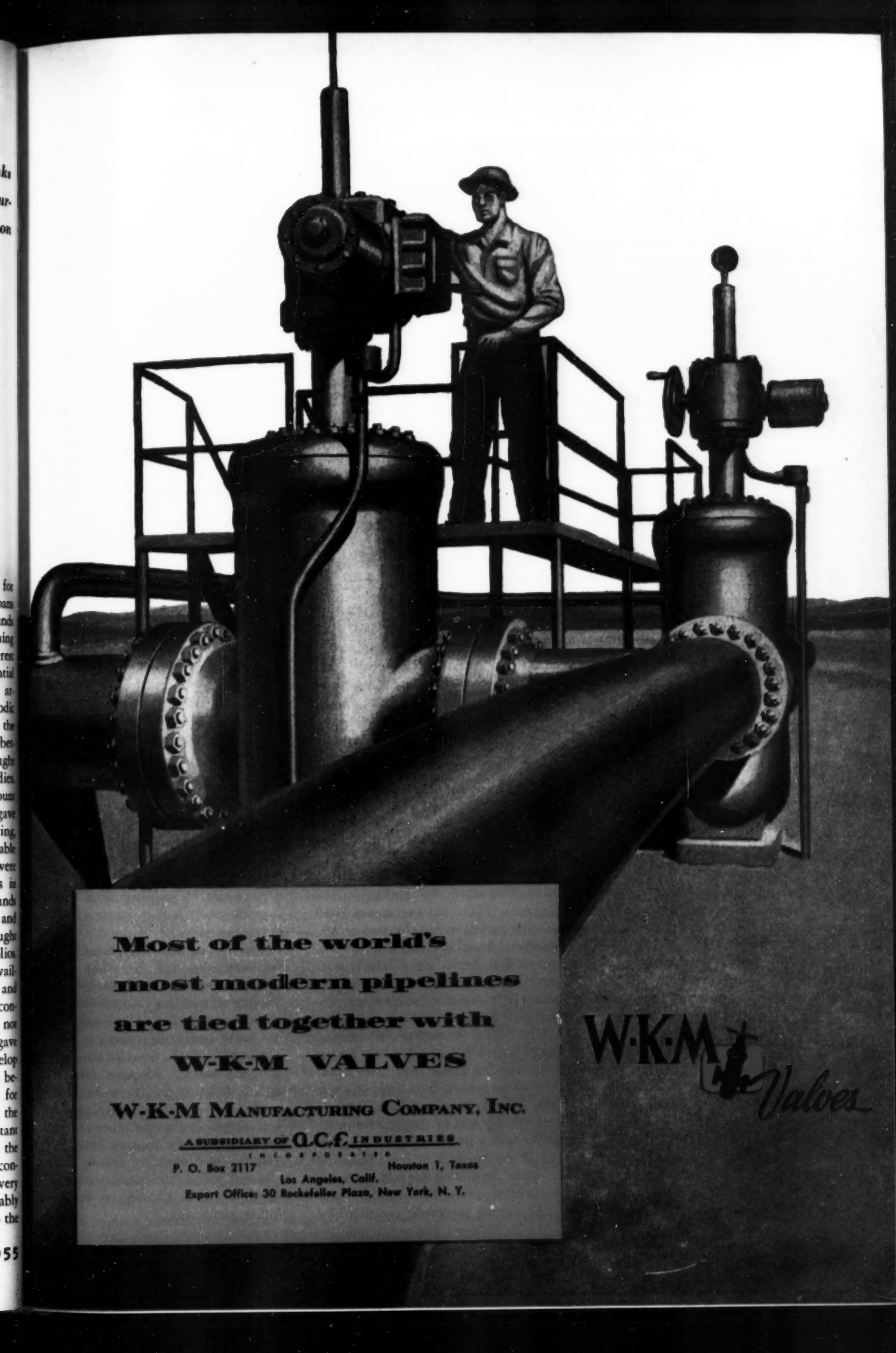
Related fields

Many of the large gas producing and transmission companies were established by organizations engaged in related fields. In its early stage the future of the industry was regarded by many as so limited in scope and speculative in character that it was necessary for the organizing companies to provide most of the senior construction money as well as the junior stock equity. During the first great period of expansion in the 1920's, the gas industry went through the usual growing pains and while, of course, there were certain companies that attained a position of stability, they were the exception rather than the rule. As time passed, however, and despite the depression of the early 1930's, the industry established a commendable record for meeting its maturing obligations. At the same time large amounts of equity money were reinvested in the industry, thereby creating additional assurance of its financial stability. As a result, confidence in the industry increased and has continued to grow so that now gas companies like most public utilities can finance, publicly or privately, at rates that compare favorably with those at which any industry is able to obtain capital.

The security markets on which the industry relies so heavily today have not always been so favorable. In the thirties, when the industry did not enjoy its present high financial standing and the political and regulatory climate was definitely unfavorable, the security markets were quite disturbed. Security financing was not only difficult but at times very nearly impossible. In the years between 1935 and 1945 funds raised through equity financing were nominal. First lien debt securities were selling at discounts and this applied to non-utilities as well. Investment resources were low and investor confidence was generally lacking.

Maintain progress

Throughout this period of indecision and gradual adaptation to changed economic and regulatory conditions, the commercial banks provided many companies in the industry with large loans to meet urgent needs and to maintain progress. Specifically, through the late thirties and early forties, the banks not only provided temporary financing for construction needs but also made loans for a variety of other purposes. Funds were provided to meet approaching maturities and to refund high-interest rate bonds, thereby saving substantial interest charges. Term loans were arranged with provisions for periodic debt reduction, thus permitting the companies to gradually achieve the better balanced capital structures sought by themselves and by regulatory bodies. Loans were made to reduce the amount of bond financing required, which gave the bonds a better investment rating, thereby making them more acceptable to conservative investors. Loans were made to assist holding companies in their divestment proceedings. Funds were provided to purchase, merge and integrate properties. Banks also bought debt securities for their own portfolios. Construction credits were made available, often for rather long periods and arranged to permit take-down in convenient installments. These credits not only saved interest charges but also gave the borrower time in which to develop earnings from the new construction before going to the security markets for permanent financing. Obviously the commercial banks had an important part in preserving the integrity of the industry and in providing for its continued development during some very difficult times. Their action probably contributed as much as anything to the



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Commercial banks ... Equity securities should be sold when the market is receptive

gradual restoration of investor confidence.

Today the gas industry is in the midst of another vast expansion program. The American Gas Association reports that expenditures of the industry in 1953 for new facilities aggregated $1.35 billion, the second highest total in history. This was the fourth consecutive year in which new construction expenditures exceeded $1 billion. The association also reports that during the four years, 1954 through 1957, total new construction expenditures will aggregate $3.9 billion. Of this total $1.2 billion will be spent in 1954, $1.15 billion in 1955 and at least three-quarters of a billion dollars a year in 1956 and 1957.

The internal cash generation will provide only about one-third of the proposed capital outlay, leaving almost two-thirds to be financed by other means. This internal cash generation is low compared with other large industrial groups. Internal capital formation in the petroleum industry, for instance, has been approximately equal to capital expenditures and these expenditures have also been huge. However, utilities generally and the gas industry in particular are more dependent on outside financing than most other large industries.

The industry's principal sources of outside funds in recent years have been the sale of debt and equity securities through public offerings and private placements with large institutional investors such as insurance companies, savings banks, pension funds and other trust funds. The commercial banks have also been an important reservoir of funds by providing relatively short-term loans pending permanent financing. These funds have been advanced principally under what is known as a standby construction credit. This type of loan arrangement has been widely accepted in the industry as being uniquely adapted to its construction requirements. Under such a credit, the borrowing company may avail itself of borrowings up to a stipulated amount during a specified period and is permitted a stated time thereafter in which to consummate a previously planned program of permanent financing.

These construction credits are usually arranged with relatively few banks. They are tailor-made to fit the particular requirements of each individual company based upon a familiarity with the borrower's affairs that results from an established banking relationship and comprehensive studies. The agreement in which the arrangements are set forth is not a standardized or rigid instrument like the elaborate indenture required in connection with a bond or debenture issue but instead provides a large degree of flexibility. This flexibility is very important because often delays in receiving equipment, shortages, over-runs or other unforeseen circumstances require major changes in a construction program. Should any of these contingencies require some modification, renewal or extension of the credit, such changes can be accomplished with a minimum of delay and expense.

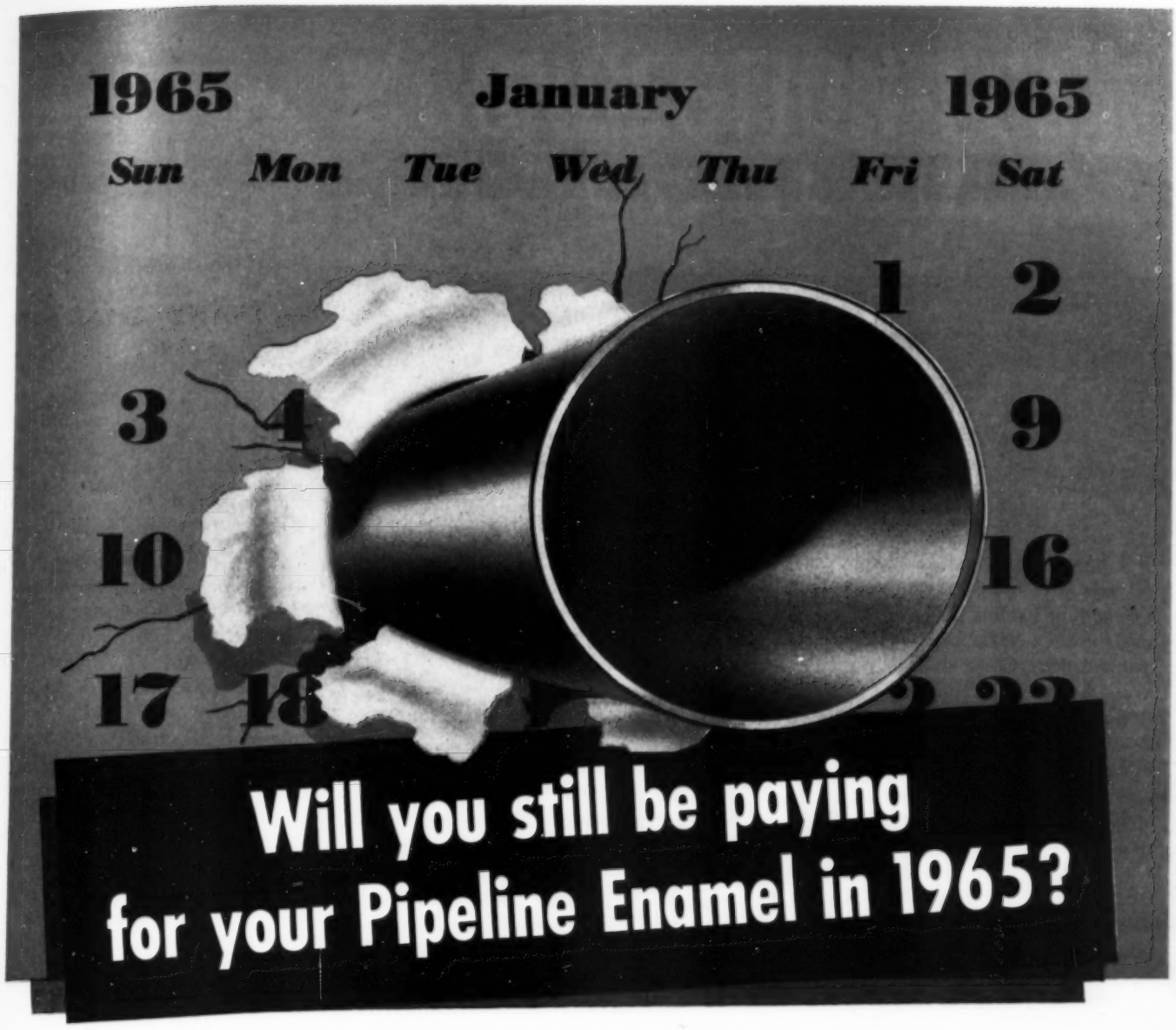
Speed and simplicity are also definite advantages of these bank loans. Once the banks are provided with full information concerning the construction program and ultimate financing plans, the funds are available promptly and with a minimum of paper work.

Of course, extending bank credit to a public utility company involves considerations differing considerably from those encountered in making loans to an unregulated industrial or commercial enterprise. By and large, commercial loans are made to facilitate business transactions involving purchase, manufacture and sale of goods, or in other words, for working capital purposes. Their pay-out comes from liquidation of inventories and receivables, and from operating earnings. For this reason, banks are primarily concerned with the current position of a prospective commercial borrower. On the other hand, utility loans are generally for capital investment purposes and the pay-out is not from working capital turn-over, but rather from cash throw-off and permanent financing, which in turn depends heavily on security markets. This is one of the reasons banks prefer utility loans that are to be paid out of the proceeds of bond financing to those depending entirely on stock financing for their payment.

Appraising the credit position of a utility company requires examination into a number of special factors including capitalization ratios, earnings, rates, and regulatory atmosphere as well as security markets. For instance, the gas industry, although fortified against some of the risks of other businesses, is extremely vulnerable to the impact of adverse regulation. One important question is always whether the regulatory bodies will permit rate levels that will result in earnings high enough to justify investor confidence in the company's securities, particularly its equity securities. Borrowers subject to regulatory procedures must keep in close contact with these bodies to assure maintenance of adequate earnings in order to preserve this investor confidence.

Obviously, the companies must also keep in close touch with their investment bankers and they, themselves, should follow carefully day-to-day conditions in the security markets. In making plans for the future it is important to recognize that financial support comes from several sources, each playing an important part in providing the various forms of capital. It is of the utmost importance for any company, and particularly for a public utility company, to have available as many avenues of finance as possible. Permanent financing must be arranged promptly because any postponement in the hope that the cost of capital will decline can be based only on a speculative premise. Unless the industry is prepared to run risks, it must adjust itself to going market rates for capital funds, just as it has accepted going market prices for materials and labor. Equity securities should be sold in periods when the market is receptive. There is serious question about the advisability of postponing sale of such securities in the expectation of higher future earnings because of the risk of the stock price failing to respond and possibly even declining. In addition, debt ratios should be kept as low as possible, leaving some reserve for emergencies.

Fortunately, it has become quite clear that what management needs to have a successful business, from the standpoint of good service, adequate rates and public support, are the same things needed to secure proper financing. One is a complement of the other and they work together as a team. As long as the industry continues to follow sound financial policies the commercial banks certainly can be counted on for their fullest cooperation. ■



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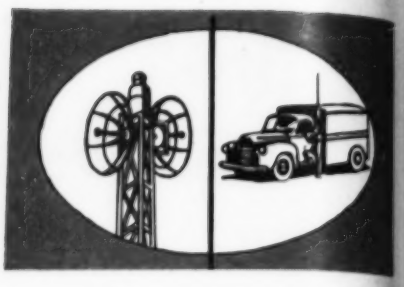


By FRANK CHAPMAN

Varying costs of mobile radio maintenance

IT is, or at least it should be, of considerable interest to the gas industry communications man that the costs and methods of mobile radio system maintenance vary widely from company to company. Although it is understandable that a certain degree of variation should exist because of the differences in company policy and the service area over which a company operates, it is nonetheless disturbing that no fairly standard set of practices has evolved from industry experience. The basic communications requirements of a gas distribution company and a gas transmission company are, irrespective of size, pretty much the same.

Set of procedures

Whenever there is no generally recognized set of procedures for a process common to an industry the implication is that a substantial percentage of the industry is not functioning at maximum efficiency. After all, it is not reasonable to assume that there are a number of equally efficient methods of accomplishing the same industry function. The methods used by some companies are more efficient, more economical and more dependable than those employed by other companies. When a widespread variation in methods and costs of maintenance is brought to light it is at once evident that either (1) the communications men within the industry are not getting together to build a set of good procedures for the industry as a whole, or (2) they are not taking advantage of the help that can be offered by an industry-wide exchange of ideas.

The variation starts with the spread in mobile radio maintenance costs within the industry. The range varies from a low of around $1 per mobile unit per month to as high as $15 per mobile per month. Some variation is to be expected because of mode of operation, but a spread of this extent in the same industry is evidence of excessive costs.

A further analysis of maintenance procedure indicates that the industry is divided into two camps. Some companies make use of a contract service organization while others make use of inside employees and handle all their own service work. The greater percentage of companies at the present time falls within the latter category.

In those instances where a company's organization can be adapted to use the services of an outside contract organization, a reasonable economy in maintenance costs will result. But because of the service area covered, not all companies can do this. In most instances, however, a well thought-out policy of maintenance making use of outside contract service can prove to be the most economical method.

Satisfactory operation

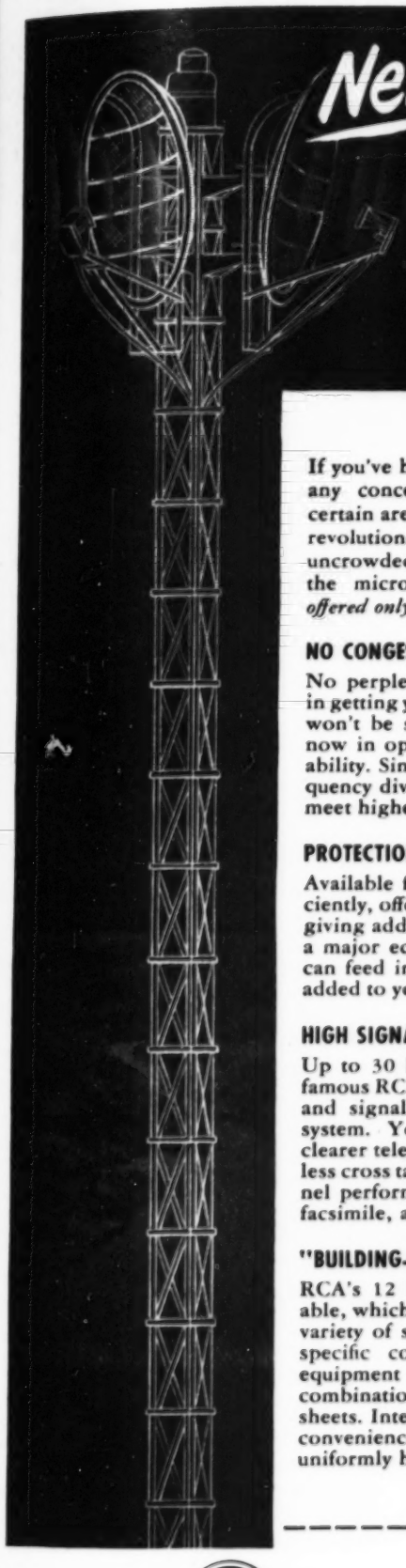
For such a system to operate satisfactorily, it is essential that the company service areas be reasonably closely situated and that qualified service personnel be available throughout the area. When this situation exists mobile communications equipment may be serviced as required or as ordered without the continuing expense and overhead of full time servicemen, equipment, and miscellaneous expense. In practice some of the companies with the most economical service records make use of this practice. Generally, servicemen are paid a retainer for making themselves available, plus a time and expenses rate for work performed.

Where company policy or the nature of the company service will not permit the use of contract service an internal service organization must be set up. The pitfalls that can make an internal service organization an expensive operation are many. Although a substantial part of the expense of such a unit is routine expense and out of the hands of the supervisor or chief engineer, there are a number of expense items, which can add up to a figure of some consequence, that fall within the realm of the communications man.

Limitations

Although experimentation is a worthy undertaking it is an expensive and time-consuming process requiring the use of specialized and expensive instruments and should not be a part of a serviceman's work. Communications has reached the stage of development where it is not possible to accomplish any worthwhile results with experimentation (with rare exceptions, of course) without the expenditure of considerable money and time. For an economical internal service operation, servicemen should be employed for this purpose alone and should not be permitted to undertake experimental research or engineering.

As an enlargement of this policy, the outlay for instruments should be kept at a minimum. In actual practice only a few basic instruments are required for



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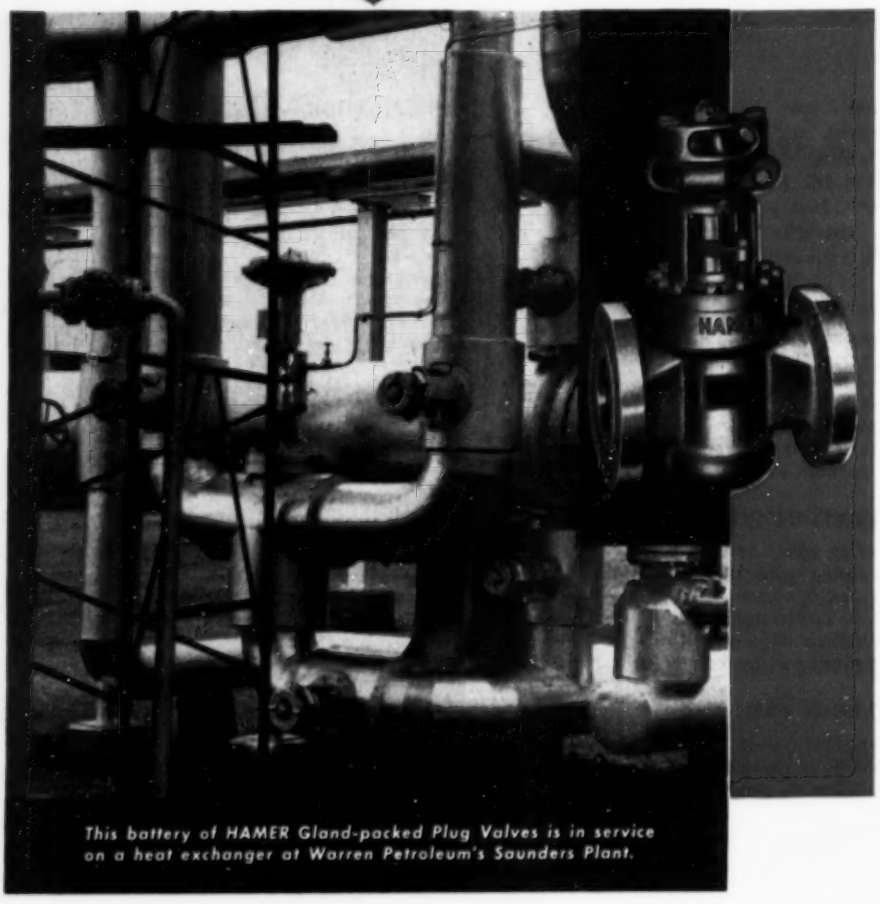

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any maintenance work that needs to be performed by the communications engineer working with present-day equipment. Aside from hand tools the average serviceman needs only a suitable volt-ohm meter, a frequency meter, and a signal generator, plus repair kits for the type of equipment installed. The outfitting of a serviceman with the necessary tools to do his job will cost in the vicinity of $1500.

Finally, to keep the cost of communications maintenance at a minimum, a well coordinated program of work scheduling should be worked out and put into practice. Mileage costs and other traveling expenses must be kept at a minimum. Maintenance calls should be dovetailed with preventive maintenance and other work which the service representative can undertake on any traveling assignment. In a great many instances the communications serviceman is also used to maintain pipe locators, telemetering equipment and many other types of electronic gear. This kind of work can be coordinated with the maintenance of communications equipment in such a way as to result in the more economical servicing of all types of electronic equipment.

Not the whole story

It must be remembered, however, that cost is by no means the whole story. A maintenance program is inadequate, regardless of how economical or how expensive, if it fails to provide the company with adequate communications facilities whenever required. The communications engineer must strive for a program that is both economical and effective.

The gas company communications engineer owes it to his company as well as to the industry of which he is a part to take a close look at his procedures with an eye to bringing the cost of his maintenance operation into line with that of other equivalent companies in the industry. To do this he must exchange information and ideas with others in the industry and put his findings into action. The results of his efforts will become evident when the gap between the maximum and minimum maintenance expense figures is closed and it is apparent that the only basic difference in maintenance costs is the result of differences in company policy and service area peculiarities.

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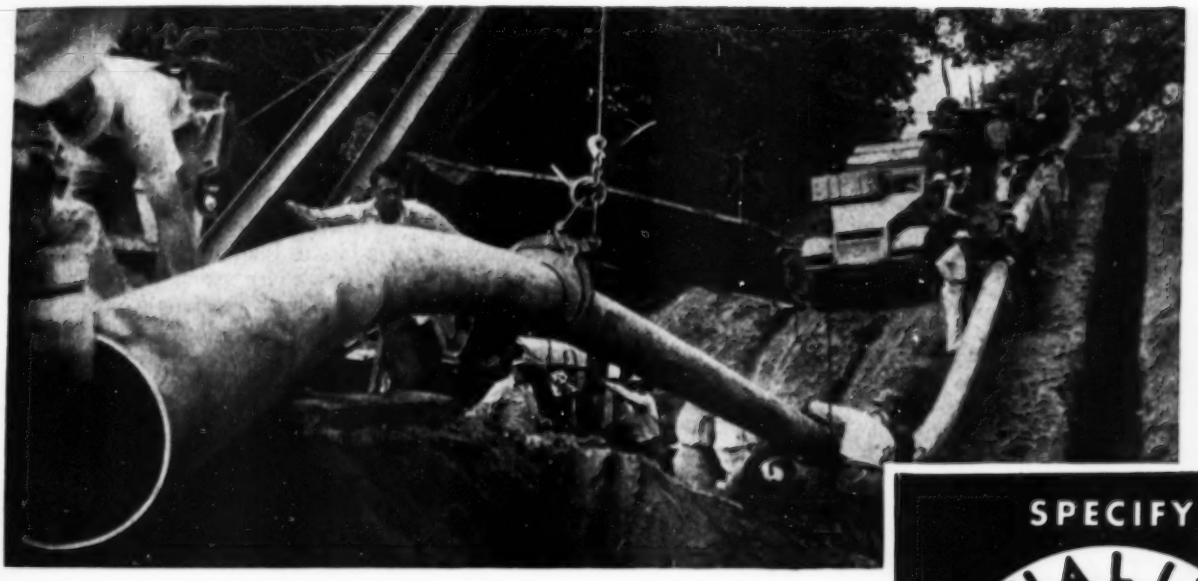

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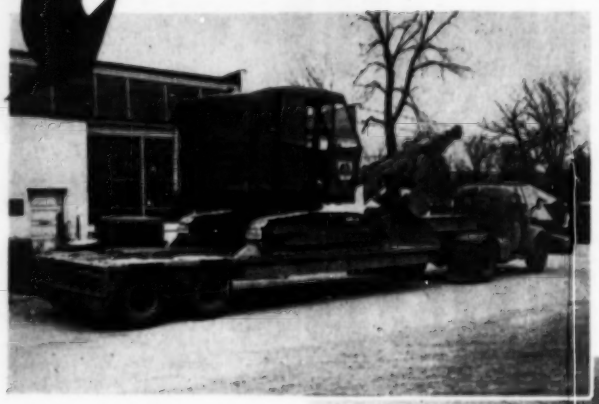

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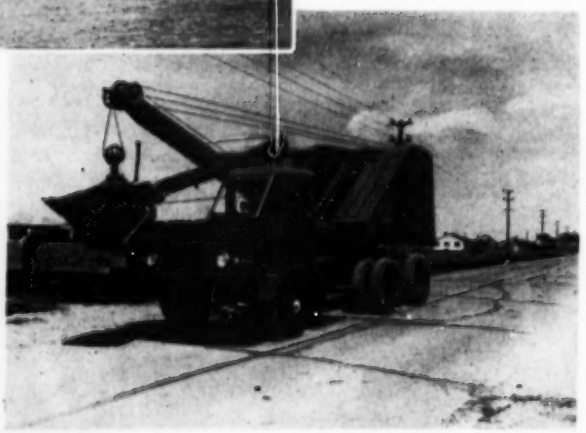

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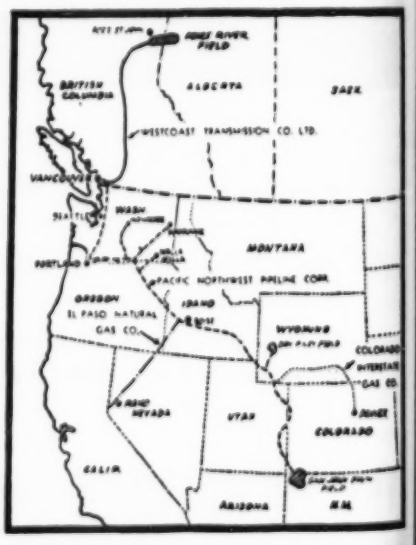
GAS pipeline news

Compromise reached by Westcoast, Pacific

A compromise agreement has been reached whereby natural gas will be brought to the Pacific Northwest from Canada as well as from the southwestern part of the U. S. Involved in the agreement are Westcoast Transmission Co. Ltd., Calgary, unsuccessful bidder to serve the Northwest; Pacific Northwest Pipe Line Corp., winner of FPC approval to serve the area; and El Paso Natural Gas Co.

Under the compromise, Westcoast, which has control of large reserves of natural gas in the Peace River area, would sell to Pacific Northwest 300 MMcf of gas daily for delivery at a point on the international boundary near Vancouver, B. C., into a line to be built by Pacific.

El paso, which expects to build a 370-mile, $35 million line from Mountain Home, Idaho to Reno, Nev. within the next three years, would purchase 250 MMcf of gas daily from Pacific at a take-off point on Pacific's line near Mountain Home, about 40 miles southeast of Boise. The remaining 50 MMcf would be used to expand Pacific's markets.



Proposed routes of various companies involved in $400 million project.

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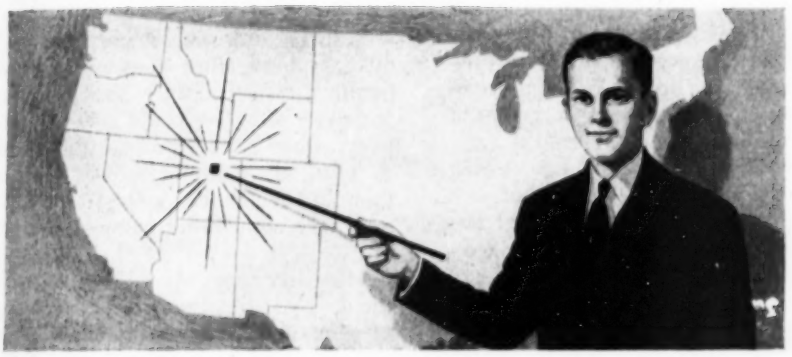
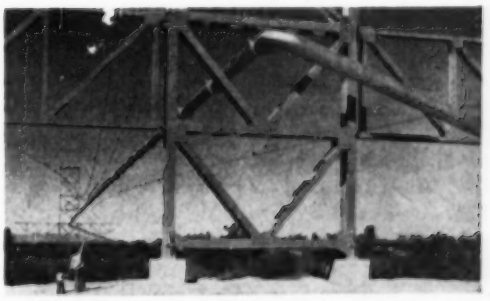


Consolidated Western Steel Builds New Pipe Plant at Provo, "The Hub of the West"... to Better Serve a Growing, Building West

Strategically centered to reach you with the greatest possible efficiency, Consolidated Western's new plant will produce and deliver the highest quality electric-welded steel pipe at the lowest possible cost. Sizes available include 4" to 40" diameters to meet the needs of transmission pipelines as well as distribution systems and industrial installations. New long length Consolidated Western pipe is engineered and manufactured to provide (1) uniform circumference and roundness insuring perfect fit-up in the field; (2) uniform diameter and wall thickness coupled with high yield strength and ductility for maximum strength per ton of steel.

Because United States Steel emphasizes quality control from mine to mill to finished steel . . . its consistently high-quality steel pipe is in demand the world over. A major portion of the world's large-diameter welded-steel gas and oil pipe has been produced by the Consolidated Western process. For 100 years, the Consolidated Western Steel Division of United States Steel has pioneered the fabrication, erection and manufacture of pipe, structural steel, plate products and mechanical equipment—constantly proving that only steel can do so many jobs so well.



PIPELINE OVER THE COLORADO. Bridging the Colorado River between Arizona and California, this 1040 foot pipeline is built from high-strength sections of 30" welded-steel pipe manufactured by Consolidated Western. This important link—connecting the El Paso Natural Gas line to the Southern California Gas and Southern Counties Gas systems—is the second largest of its type in the world.

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HOT DOPE

Straight from the Kettle on *PIPE PROTECTION*

★

By Boyd Mayes

• Most times I agree that the shoemaker should stick to his last and pipe liners to pipe — but, since everybody is having his say on the FPC, gas transmission problems and price at the wellhead — 2feel it's fair to the public to remind 'em that all those words both pro and con which could confuse are covering up something *much more important than price issue.* As we see it — IT'S A MATTER OF PRINCIPLE or basic rights in business. We always figured that when a man got out of line — the law should get after him. But if he's a good member of the citizenry and disciplines himself — we never felt the law should lecture him. Seems to us somebody in the government was anticipating trouble — not waiting for any evidence of it. And we don't know of anything that regulates price better than competition between buyers and producers. Reckon that's somewhat the opinion of a lot of folks on this new problem.

But now back to my pipe yard — we're happy to offer to those who need it, the finest in men, equipment and know-how in your pipe salvaging, coating and wrapping problems.

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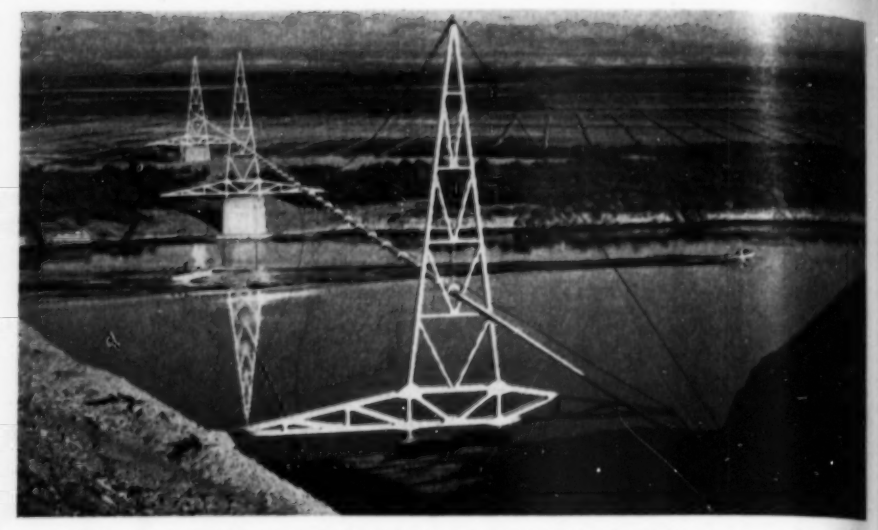


Nevada Natural Gas Pipeline Co.'s recently completed pipeline bridge across the Colorado river near Needles, Calif., is located near the southern end of Nevada Natural's 114-mile line between Las Vegas, Nev. and a connection with El Paso Natural Gas Co.'s line on the Arizona side of the Colorado river south of Needles. The bridge replaced the temporary line that was laid in the bottom of the river.

El Paso would deliver the gas to the Reno area, where, according to report, it would connect with a line of Pacific Gas & Electric Co. of San Francisco. The arrangement would involve construction of a line by PG&E to Reno from its present system in northern California, an official of El Paso explained. However, PG&E has denied that it is a party to the agreement.

Pacific Northwest was certified last June to deliver 245 MMcf of gas daily to the Northwest via a $160 million, 1466-mile system, which would go through New Mexico, Colorado, Wyoming, Idaho, Oregon, and Washington. Colorado Interstate Gas Co. is to get 100 MMcf of this gas for the Denver area (see GAS, August 1954, p. 89). Preliminary construction work has begun on Pacific's line.

Gas sold to El Paso will presumably come from the San Juan area. Sale will be by displacement only.

Westcoast, which plans to withdraw its appeal against the FPC decision authorizing Pacific's proposed project, will build a $120 million, 600-mile system from the Peace river area to Vancouver, B. C. and Sumas, Wash. Westcoast is aiming for initial deliveries sometime in 1957.

C. H. Gueffroy of Portland Gas & Coke Co., the principle advocate of Canadian gas for the Pacific Northwest during the long battle preceding the FPC's June decision, is optimistic about the aspects of rapid FPC approval of the new plan, although it has not been put up to the FPC at press time.

It is estimated that the entire project will involve expenditures of $400 million.

Sale to other pipelines would be profitable to CIG

Ralph E. Davis, independent gas and oil consultant from Houston, testified before the FPC recently that Colorado Interstate Gas Co. could sell its company-owned gas in the Panhandle field in Texas for from 12 to 15 cents per thousand feet under a long term contract with some other natural gas pipeline.

His testimony was slated to mark the end of the direct evidence being presented by Colorado Interstate in the rate hearings on two applications for increases.

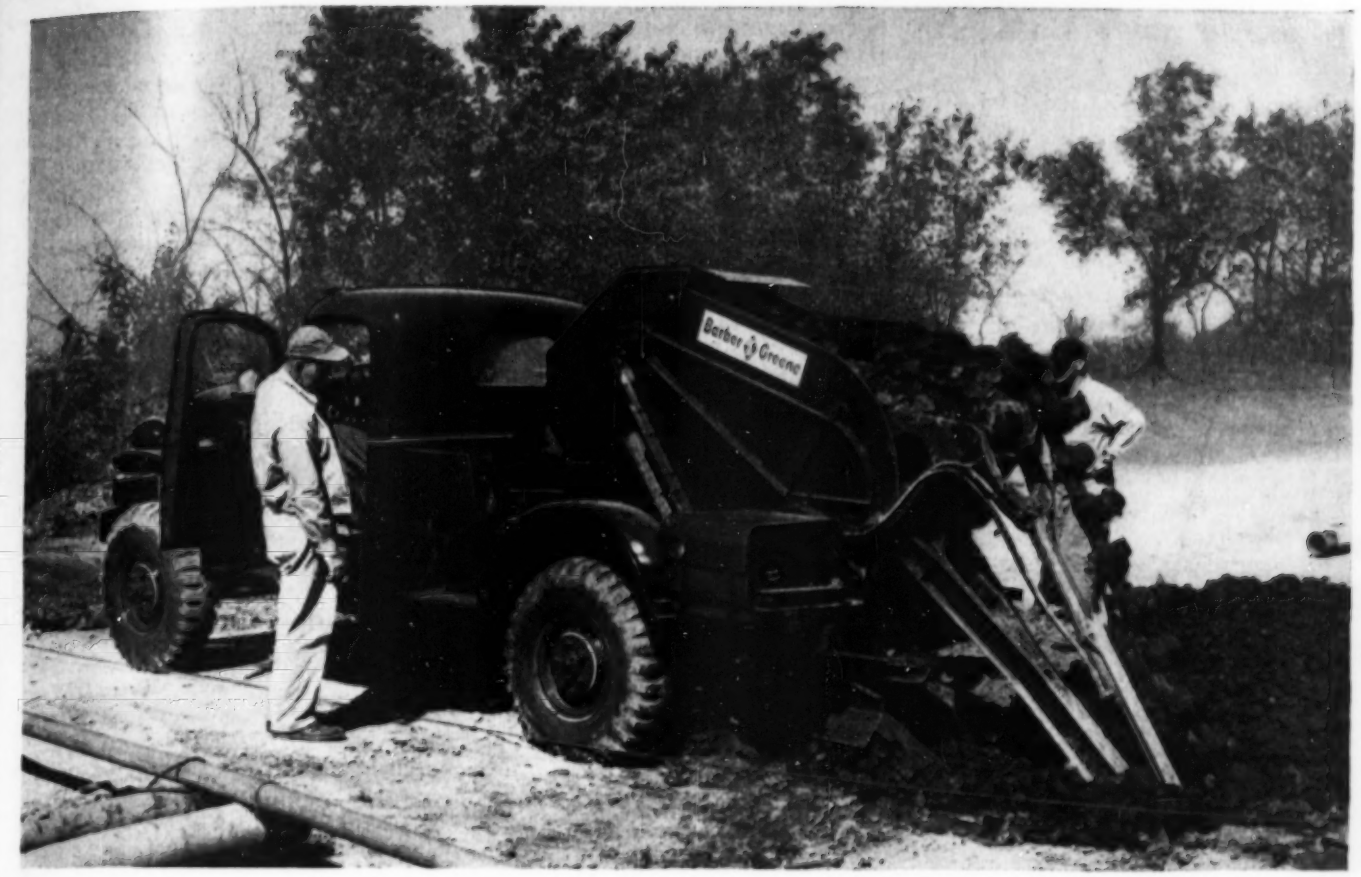
Colorado Interstate is asking the FPC to authorize a price of 9.19 cents a thousand cubic feet for gas produced by the company in the Panhandle field and distributed through its pipeline for the use of its customers. Currently it is allowed only 1.92 cents a thousand cubic feet.

TGT seeks to merge two gathering subsidiaries

Texas Gas Transmission Corp., Owensboro, Ky., has applied to the FPC for authorization to merge two south Louisiana gas gathering subsidiaries into the parent company.

The subsidiaries are Louisiana Natural Gas Corp. and Texas Northern Gas Corp., both of Lake Charles. They primarily are engaged in the acquisition of gas reserves in the Louisiana Gulf Coast area for delivery to Texas Gas.

W. T. Stevenson, president of Texas Gas, said the merger would effect some



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economies in operation and simplify the corporate structure. E. F. Hindman, presently general manager of the two subsidiaries, would become manager of the Louisiana division of Texas Gas under the proposed merger. Division offices would remain in Lake Charles.

El Paso will seek new hearing on rate decision

El Paso Natural Gas Co. plans to ask for a rehearing of a recent rate decision in which the FPC granted the company rate increases but also ordered certain refunds to customers. El Paso was allowed about $10.4 million of a requested $13.3 million.

The FPC held that "a rate of return of 6% for El Paso is fair, reasonable and adequate." It also allowed El Paso to charge as an item of its cost of service the same field price for gas produced by the company as was paid to non-pipeline producers.

The company estimated that the refunds, which will amount to about $1.9 million for 1953 and $2.4 for the 12-month period ended Sept. 30, 1954, are not justified because when the company computes its earnings on a 6% rate of return and makes all other adjustments called for, it would be required to make little or no refund for the year 1953 and "certainly none for the year 1954."

In other recent rate actions, the FPC ordered Northern Natural Gas Co. to refund $2,824,105, plus 6% interest, to 26 of its wholesale customers; suspended all but about $211,000 of an $18,113,000 increase filed by El Paso; allowed a $449,000 increase of Manufacturers Light & Heat Co. to go into effect; suspended increases of $3,204,330 and $8,616,000 of Transcontinental Gas Pipe Line Corp. and Tennessee Gas Transmission Co., respectively; and modified its July 30 order to Michigan Wisconsin Pipeline Co. so that the company gets a $3,726,722 raise instead of $2,829,200.

Canadian gas needed for industrial expansion

Montana Power Co.'s president, J. E. Corette, has testified before the FPC that under present circumstances it would be impossible to extend natural gas service to Missoula if Canadian gas is not imported. Withholding Canadian gas from the Montana market would have an adverse effect upon industrial development of the area, he added.

In support of Montana Power's case to import gas from Canada, a former Anaconda Copper Mining Co. official said if the ACM in Montana is forced by lack of natural gas to switch to other types of fuel (probably oil), fuel costs would rise substantially and operations in Butte, Anaconda, and Great Falls would be adversely affected.

PG&E will tap new fields for additional supplies

An $850,000 gas line 18 miles long will be built in Colusa and Glenn counties, California, by Pacific Gas & Electric Co. to bring additional natural gas into the middle Sacramento valley from two new fields. The line will tap the Beehive Bend field in Glenn County and the Princeton field in Colusa and will strengthen gas supplies as far north as Sacramento.

Initial deliveries from the fields are expected to average about 6 MMcf per day, subject to increase if additional wells are successful.

A 12-in. line will originate in the Beehive Bend area, extending south to a point near the town of Princeton, where a tap will run into the Princeton field, and then will be laid to a point about seven miles west of Gridley. At that point, the Beehive Bend-Princeton gas will be mixed with gas from the Wild Goose field.

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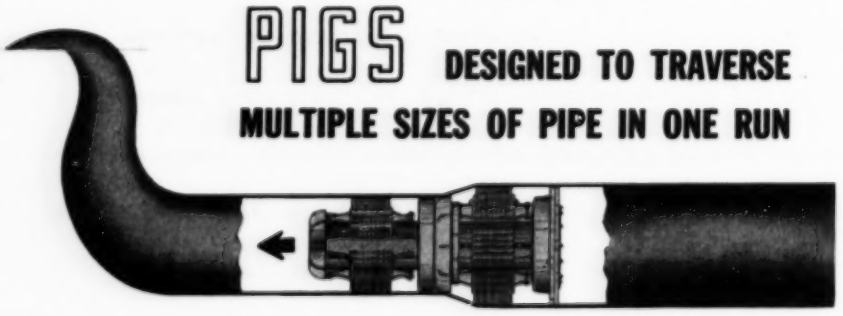
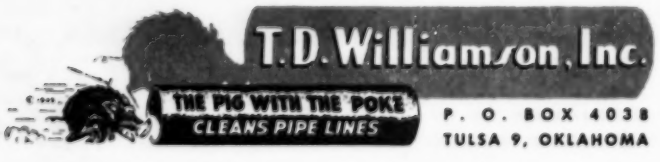


DUBL-DIAMETER PIGS CONFORM TO THE CHANGES IN PIPE DIAMETER MAINTAINING SEAL FOR CONTINUED PROPULSION



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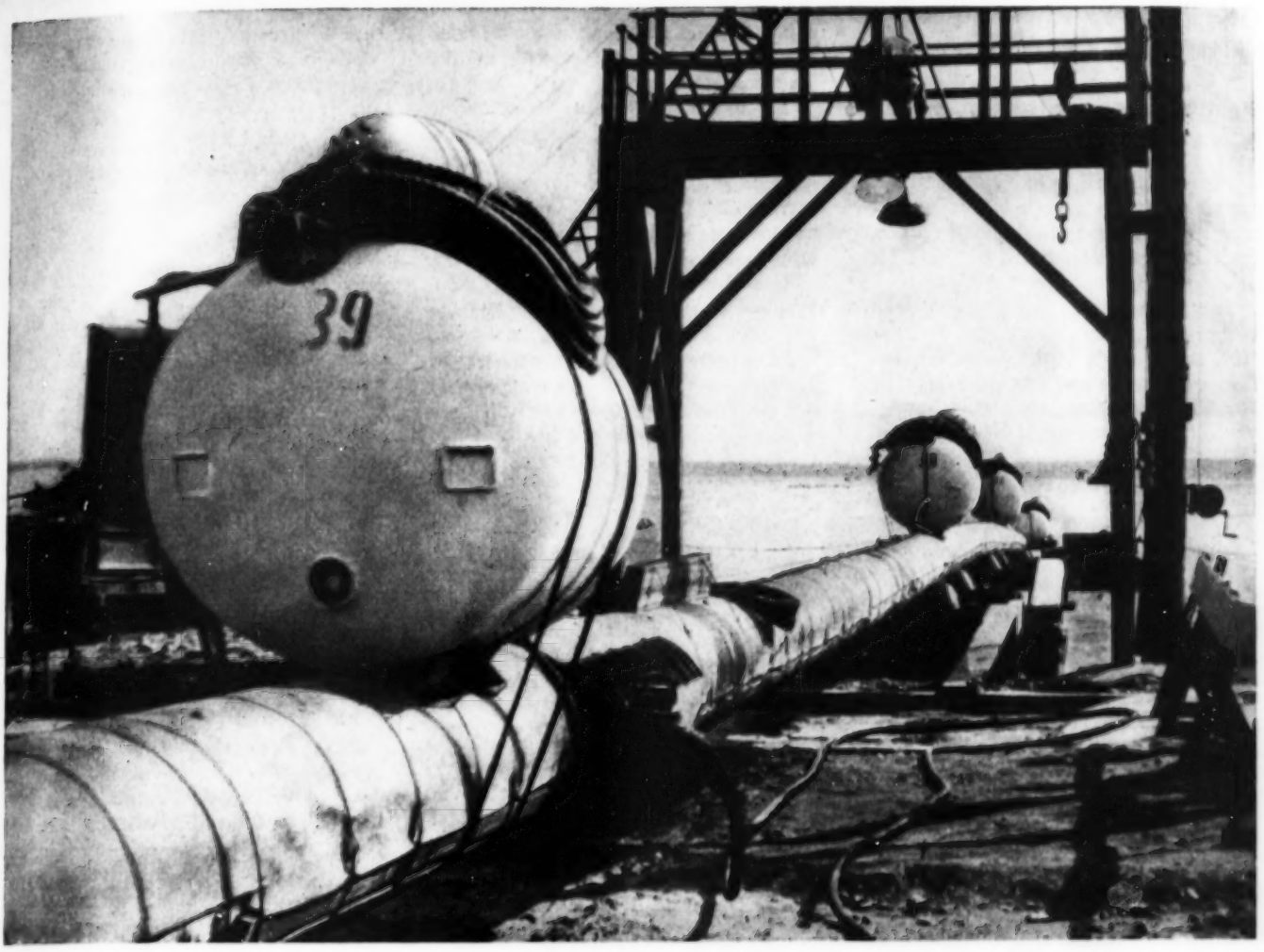
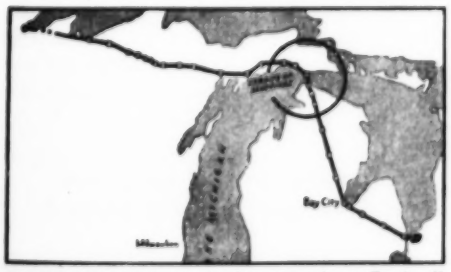


Under the Straits of Mackinac . . . under wraps of Coromat



NO BOTTLENECK due to ice-bound tankers. Crude oil now flows under 230 ft. of water in pipelines protected from corrosion by Coromat.

WRAPPED and ready to go. After Coromat was applied, 2500-ft. sections of pipe were pulled by winch with two-inch steel cable.

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The two 20-in. lines pulled 22,000 feet across the Mackinac Straits form a vital link in the Lakehead Pipe Line Company's crude oil line from Superior, Wis., to Sarnia, Ont. These 20-inchers run as deep as 230 ft., and *cost 8 million dollars to lay!*

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COROMAT is distributed nationally by: Midwestern Engine & Equipment Co., Inc. Tulsa, Oklahoma; Perrault Equipment Company, Tulsa, Oklahoma.

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Proposed cancellation of sales by Skelly to be heard

Plans for Skelly Oil Co., Tulsa, to cancel a contract and to terminate natural gas deliveries to Lone Star Gas Co., Dallas, will be heard by the FPC this month.

The contract that Skelly proposes to cancel covers the sale of gas to Lone Star from Skelly's Velma gasoline plant. The commission said that the sales take place in Oklahoma, after the completion of the processing of the gas at the gasoline plant, for transmission by Lone Star to its mainline system in the Petrolia, Texas area.

The FPC said that with respect to the sale of natural gas to Lone Star, Skelly, under the Supreme Court's decision in the Phillips case, is a natural gas company under the Natural Gas Act, and that the sale of natural gas by Skelly to Lone Star is subject to FPC jurisdiction.

The commission's order directs Skelly to show cause at the January hearing (1) why it should not be determined to be a natural-gas company under the Natural Gas Act; (2) why it should not be required to comply with provisions of the act; and (3) why it should not be directed to continue the sale and delivery of natural gas to Lone Star in accordance with the terms of its contract.

Kansas intrastate company to serve industrial users

Kansas Pipe Line Corp. Inc. has been formed in Kansas by interests of Clint W. Murchison, Dallas oilman and financier, to develop an intrastate pipeline mainly for supplying industrial users in the Wichita area.

The proposed 16-in. to 20-in. line would have a capacity of about 100 MMcf per day. The source of supply will probably be Barber and Harper counties, about 100 miles west of Wichita, although it might be necessary to go as far west as the Hugoton field in Kansas. It is estimated that the line would cost more than $5 million.

Texas Gas loses fight against Tennessee taxes

A Supreme Court hearing has been denied Texas Gas Transmission Corp., Owensboro, Ky., on its objection to paying Tennessee franchise and excise taxes. The state's rights to collect these taxes from Texas Gas had been upheld by the Tennessee supreme court.

The company, which wanted to get back some $64,000 it paid Tennessee under protest, contended it is exempt from the state levies because its operations involve interstate commerce rather than intrastate business in Tennessee.

In upholding the state tax, the Tennessee court agreed that the company is involved in an exclusively interstate business but held that the levies were valid because they were merely a tax on the company's privilege of doing business in Tennessee as a Tennessee corporation. The state said that although Texas is technically a Delaware corporation, it operates in Tennessee as a Tennessee corporation.

Transco would increase deliveries by 69.4 MMcf

Transcontinental Gas Pipe Line Corp., Houston, has requested authority to construct new facilities designed to increase gas deliveries to existing customers by a total of 69,380 MMcf per day (FPC Docket G-4185).

The $38,316,000 project would include approximately 292 miles of 36- and 30-in. line paralleling sections of Transco's existing system in Louisiana, Mississippi, Alabama, Georgia, North and South Carolina, Virginia, Maryland, and Pennsylvania. Also called for are three river crossings, a 1650-hp addition to compressor station, and miscellaneous additions to existing stations.

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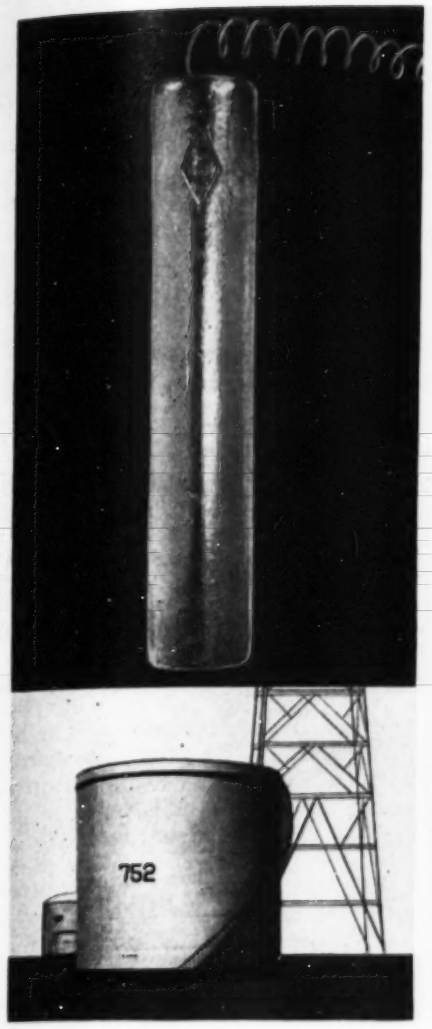

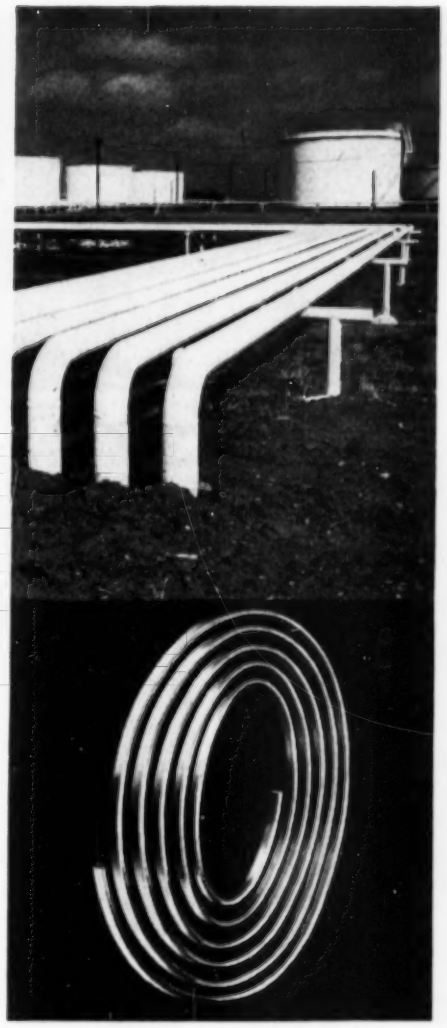

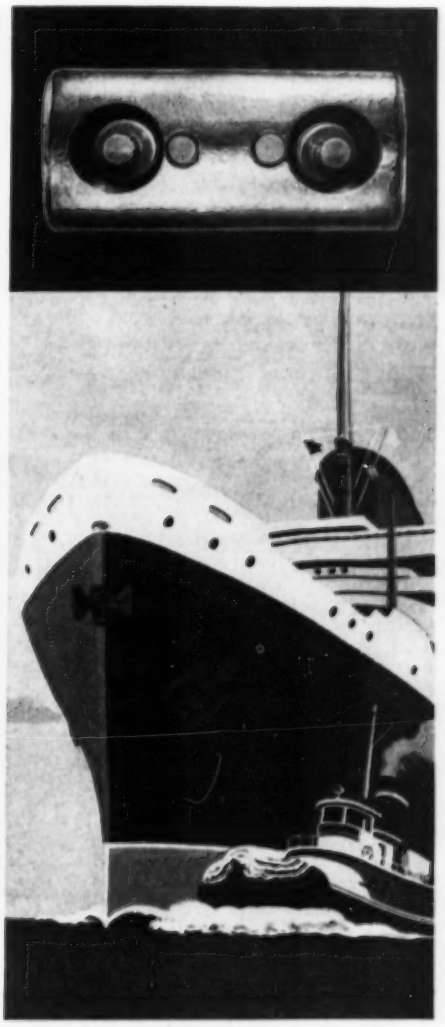

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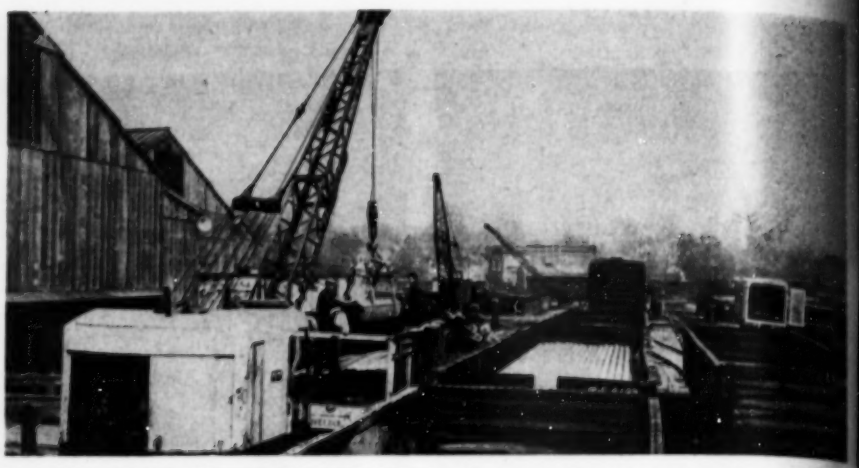
Texas Gas' 1955 program to cost $17.5 million

Texas Gas Transmission Corp., Owensboro, Ky., plans to file an application with the FPC for authority to expand its pipeline capacity by 111 MMcf per day under a proposed 1955 construction program costing $17.5 million.

President W. T. Stevenson said his company would be able to go ahead with the proposed expansion without signing any new gas supply contracts.



Standard Pipeprotection Inc., St. Louis, has doubled the length of its yard trackage to the extent that the yard can now accommodate 25 carloads of pipe, loaded or unloaded in one day, from or onto SPI's layout of skidways. Facilities also provide for rapid loading and unloading of trucks.

The proposed program would increase peak day capacity to 1.18 billion cu ft of gas. A second expansion program, planned for 1956, would add another 85 million to the system's capacity at an estimated cost of $18.6 million.

The 1955 program includes 81 miles of 26-in. loop, a new lateral to supply demands of the Indiana Gas & Water Co.; the addition of 15,460 hp to existing compressor stations, and a new 4500-hp station at Riverton, La. These facilities include those necessary to make an off-peak sale to American Louisiana Pipe Line Co. near Slaughters, Ky., of about 18 billion cu ft a year. With the completion of this step, TGT's system will be completely looped from Bastrop, La. into Kentucky, with a four-line system from Monroe, La. north to Memphis.

Denver to use Colorado gas if line is approved

Natural gas from the fields of northeastern Colorado will be piped into Denver's metropolitan area for the first time in history if the Colorado PUC approves a pipeline application filed by Natural Gas Producers Inc., a wholly owned subsidiary of Colorado Interstate Gas Co.

Natural Gas Producers, which gathers and transmits gas in Morgan and Logan counties, is seeking a certificate of convenience and necessity to build facilities to provide gas service to the towns of Fort Morgan and Brush from the Adena, Fort Morgan, Little Beaver, Badger Creek and Bobcat fields, and also to provide a connecting link between those fields with Colorado Interstate's main transmission line from the

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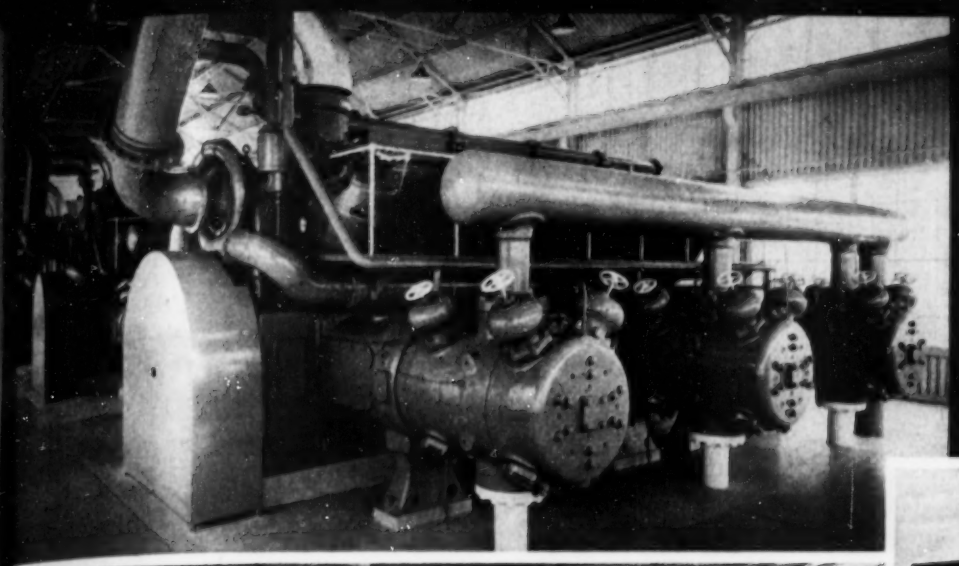
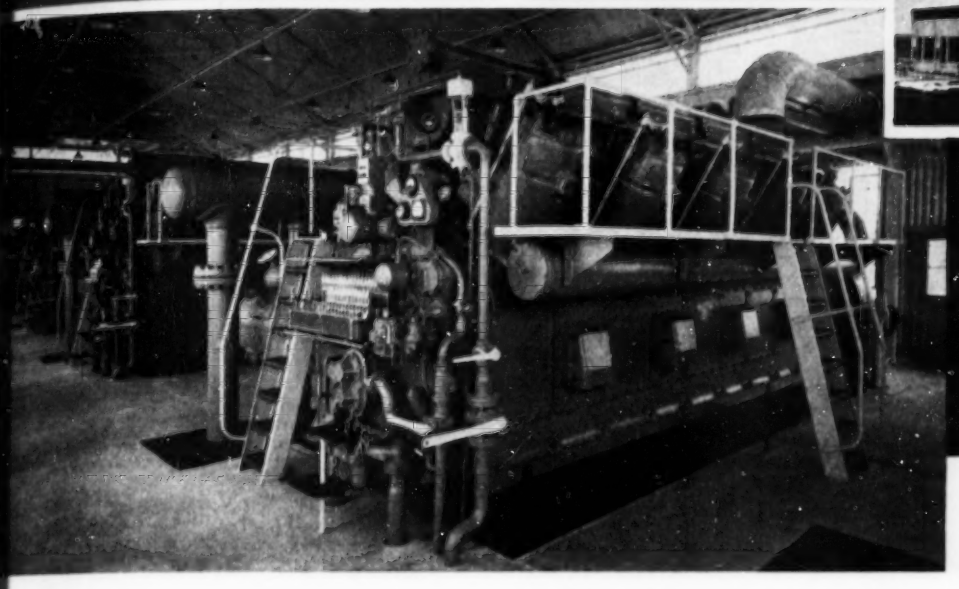


These installation photos show the new Cooper-Bessemer GMVA compressors which are identical in both the Keyes, Oklahoma and Springfield, Colorado transmission stations of the Colorado Interstate Gas Company. Below are exterior views of the compact Keyes (left) and Springfield (right) stations.



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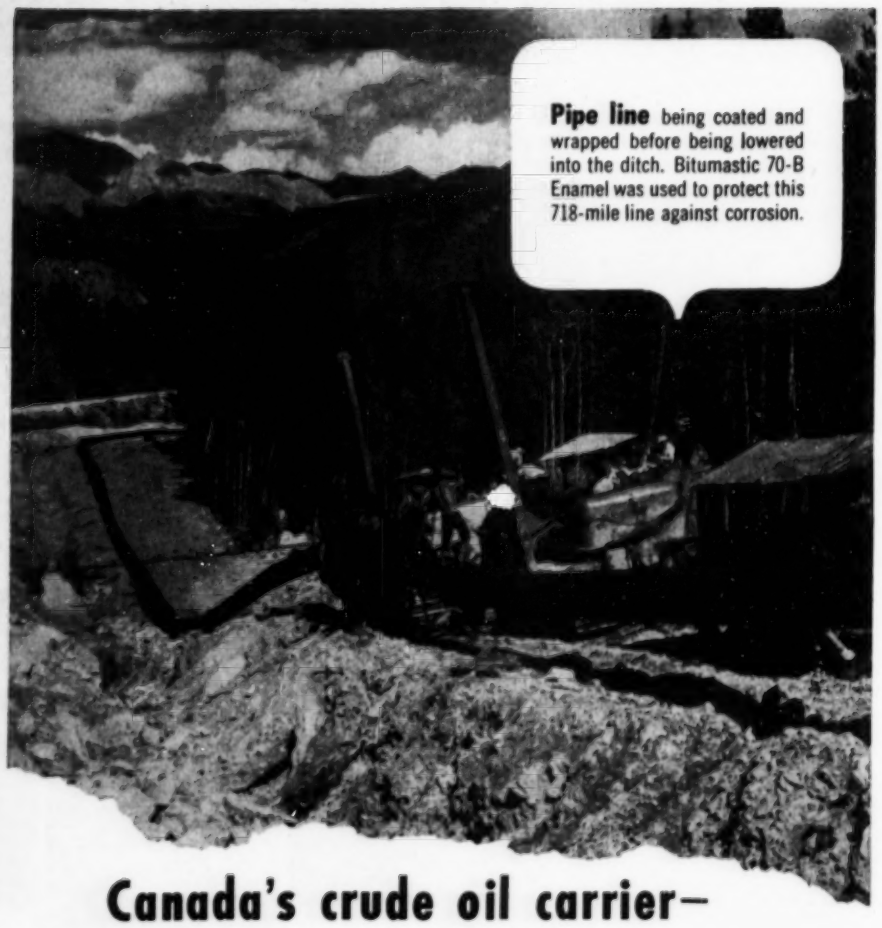

Pipe line being coated and wrapped before being lowered into the ditch. Bitumastic 70-B Enamel was used to protect this 718-mile line against corrosion.

Canada's crude oil carrier—

Trans Mountain Oil Pipe Line

—protected by Bitumastic 70-B Enamel

A river of oil now rolls all the way from Edmonton, Alberta, to Vancouver, British Columbia—a distance of 718 miles. Each day, more than 100,000 barrels of crude oil can be pumped through the Trans Mountain Oil Pipe Line that was recently completed.

Building this new 24-inch pipe line wasn't easy. Mountains had to be climbed. Rivers had to be forded —forded, at times, by using sealed sections of pipe as pontoons for temporary bridges. In some mountainous terrain, after using trucks, tractors and winches, pipe had to be carried into position, piece by piece.

A pipe line laid in such rough terrain deserves exceptional protection against corrosion. Recognizing this, Trans Mountain has coated the exterior surfaces of its new line, all 718 miles of it—with Bitumastic® 70-B Enamel. More than 20 years of satisfactory service protecting oil and gas pipe lines prove that Bitumastic 70-B Enamel is an excellent corrosion barrier.

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Tar Products Division, Dept. 165-T, Pittsburgh 19, Pennsylvania

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Hugoton, Kan. field to Denver.

Plans are to construct 48.7 miles of 10-in. line from the northeastern Colorado gas fields to CIG's 20-in. line and to build 3 miles of 8-in. and 10.1 miles of 4-in. line, which, with an already existing line, will connect the Adena field with Fort Morgan.

In addition to the lines, the application calls for the construction of meter stations and dehydrators with the total cost of the project estimated at $1,374,000.

Panhandle petitions court to halt American Louisiana

In a petition to the U. S. court of appeals in Philadelphia to stay the FPC's order conditionally permitting American Louisiana Pipe Line Co. to build its $130 million line from Louisiana to Michigan, Panhandle Eastern Pipeline Co. listed 30 reasons why the FPC order should be stayed.

American Louisiana will oppose the petition, which contends that the new line would "further the American Natural Gas Co.'s monopolistic program in the Detroit area."

An American Louisiana spokesman claims that Panhandle is advancing the same contentions that were rejected by the FPC both when it granted the certificate to American Louisiana and when it turned down Panhandle's plea for a rehearing.

Meanwhile, American Louisiana announced that applications for certificates of public convenience and necessity to serve its system were filed with the FPC by Superior Oil, Stanolind Oil & Gas, Kerr-McGee Oil Industries, and British-American Oil Producing Co. These companies have committed reserves sufficient to provide the full requirements of the new pipeline for 18 years.

FPC acts on rate cases concerning independents

The FPC, in a series of actions affecting independent natural gas producers, has terminated suspension proceedings in four cases and allowed the rate increases to go into effect, allowed parts of increases to take effect in two cases, and shortened the suspension period in two other proceedings.

The suspension proceedings involve J. C. Trahan, et al., for a $135,106 annual increase; Arnold O. Morgan, for a $24,044 increase; and Humble Oil & Refining Co., for a $21,599 and $1250 increase.

In its other actions, the commission

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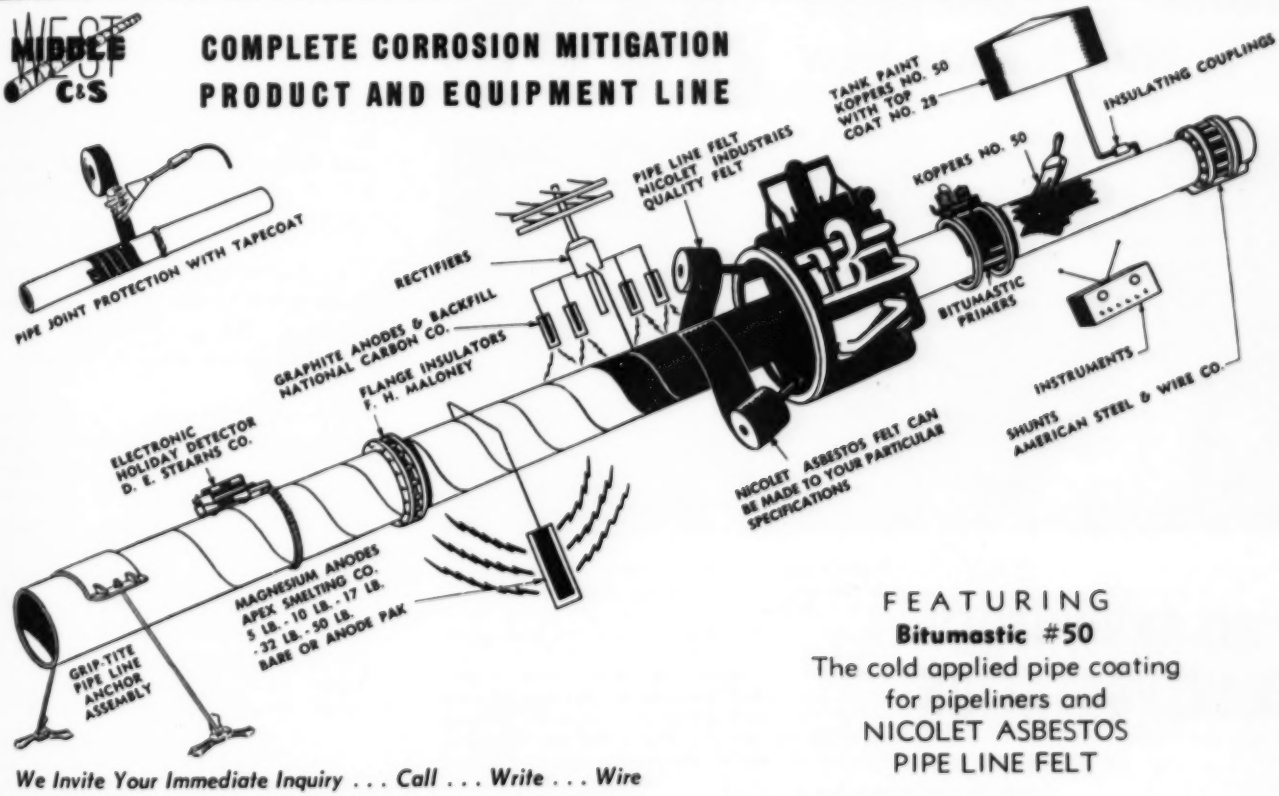
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pipeline news • *Cont'd.*

allowed certain rate schedule supplements filed by Phillips Petroleum Co. to go into effect to permit the company to recover part of an increase in the Texas production tax.

In another action involving Phillips, the FPC said it would allow the company to file new supplements allowing about one-half of the increase previously suspended for sales to Michigan-Wisconsin Pipe Line Co. The remainder of the increase proposed by Phillips in this proceeding will remain under suspension pending hearing and decision. The FPC previously announced that it planned to modify this suspension order to give equal treatment to Phillips with that accorded to other producers since the Supreme Court's decision in the Phillips case.

Northern Natural will retain uniform rates

Subject to review by the FPC, a decision has been filed which rules that the use of uniform rates for its entire natural gas system by Northern Natural Gas Co., Omaha, should not be changed at the present time.

The decision dismisses without prejudice complaints by three of Northern's wholesale customers who had urged the establishment of rate zones on the company's system in lieu of the present use of uniform rates. The establishment of rate zones also was recommended by the commission staff, while Northern and other customers opposed any change.

GAS pipeline notes

Texas Natural Gasoline Corp., Tulsa, has started construction of a natural gasoline plant to process gas produced in the Jameson and Fuller-Coke fields in northwest Coke county. The plant is to have an ultimate capacity of 70 MMcf per day and process more than 800,000 gal. daily of products.

It is reported that several major oil companies are considering the possibility of establishing a natural gas extraction plant at Newcastle, Wyo. The proposed plant would utilize gas now being flared in the Clareton oil field.

The Valley Gas Corp., Artesia, N. M., will build a quarter-million-dollar extraction plant in northwest Lea and northeast Eddy counties in New Mexico. The plant will have a capacity of 5 MMcf of gas a day.

Natural gas producers in the Texas Panhandle are receiving about 15% more for their gas than a year ago, the Texas Railroad Commission reports. Gas sold at 16.4 psi averages 9.125 cents per Mcf, compared to 7.9376 cents last year. Sales made at 14.65 psi average 8.1513 cents compared to 7.0906 last year.

Commissioner Seaborn L. Digby has been elected by the FPC to serve as vice chairman during 1955. He succeeds Commissioner Claude L. Draper.

Operating revenues of pipeline companies totaled $112,577,434 in September and $1,548,453,504 for the 12-month period ending in September, according to FPC report. The figures represent increases of 8.8% and 14.8% respectively over last year. Utility operating income for the same month amounted to $17,633,436 and for the 12-month period to $246,770,320, higher by 19.6% and 13.5% than reported in a similar period in 1953.

Marshall Hyde has been appointed distributor in the Michigan area by Pipeline Coating & Engineering Co. Inc. and Plico Inc., Los Angeles. Mr. Hyde headquarters in Port Huron, Mich.

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GAS progress reports

EL PASO (TEXAS) NATURAL GAS CO. To build 370-mile line from Mountain Home, Idaho to Reno, Nev., to handle gas destined for California customers and supplied by Pacific Northwest Pipeline Corp.

KANSAS PIPE LINE CORP., Wichita. A 125-mile, 16- to 20-in. line from Barber county fields in Kansas to Wichita to serve industrial customers.

NATURAL GAS PRODUCERS INC., Colorado Springs. To construct 48.7 miles of 10-in. from northeastern Colorado gas fields to Colorado Interstate's 20-in. line and 3 miles of 8-in. and 10.1 miles of 4-in. line to connect Adena field with Fort Morgan.

PACIFIC GAS & ELECTRIC CO., San Francisco. An 18-mile, 12-in. line in Colusa and Glenn counties to bring gas into Sacramento valley from two new fields.

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. To add 111 MMcf per day to system capacity, will build 81-mile, 26-in. loop; and 15,460 hp to existing compressor stations; and a new 4500-hp station at Riverton, La.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-4185 for 292 miles of 36- and 30-in. line paralleling sections of existing system. Would include three river crossings, a 1650-hp addition to previously proposed station and miscellaneous additions to existing stations.

WESTCOAST TRANSMISSION CO. LTD., Calgary. To build 600-mile line from Peace river area to near Vancouver, B. C., to connect with line of Pacific Northwest Pipeline Corp. to transport 300 MMcf of gas daily.

CURRENT CONSTRUCTION

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

OHIO FUEL GAS CO., Columbus. Docket G-2464 3000 hp in additional compressor facilities at its station in Fairfield county. Scheduled for completion in January.

OHIO FUEL GAS CO., Columbus. Docket G-2522 880-hp compressor station under construction.

PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo. Docket G-2433 for 575 miles of new line (294.6 miles approved), mainline loops, storage, lateral and gathering lines in Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan and 113,000 hp in additional compression. Also includes development of Waverly storage field in Morgan county, Ill. Will increase peak-day delivery capacity from 970 to 1425 MMcf daily. Approved portion virtually completed. Balance awaits FPC approval.

SOUTHERN NATURAL GAS CO., Birmingham. Docket G-1907. Construction on 150 miles of 18-in. and 4400-hp station remain for completion in 1955.

SOUTHEAST ALABAMA GAS DIST., Birmingham. A "U" shaped system of about 330 miles to serve 24 communities in southeastern Alabama from connections with Southern Natural.

APPROVED

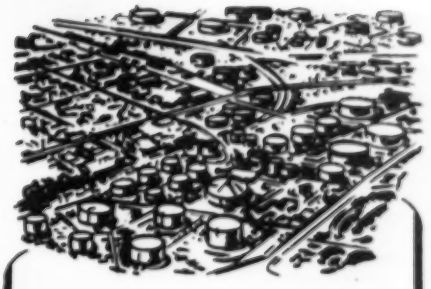
ALBERTA GAS TRUNK LINE CO. LTD., to build 130-mile gathering line near Edmonton-Bonnie Glen line south to Calgary; 80-mile line to Bassano, and 130-mile line to Saskatchewan boundary to gather and move gas to meet Alberta's requirements and export needs of TransCanada Pipe Lines Ltd.

GAS pipeline people

Texas Eastern Transmission Corp., Shreveport, has elected J. W. HARGROVE vice president and B. P. SMITH JR. treasurer. Mr. Hargrove, who is also secretary of TET, will manage the company's financing.

B. P. Smith Jr. **J. W. Hargrove**
Texas Eastern

Koppers Co. Inc., Pittsburgh, has named MELVIN S. GRIFFITH JR., who has been industrial relations manager of the metal products division, to the post of industrial relations manager for the entire company. Koppers has also named DR. A. R. POWELL acting manager of the central research department, following the resignation of DR. G. F. D'ALELIO.



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HARRISON H. HANCE has been put in charge of advertising and publications for Kaiser Steel Corp., Oakland, Calif. Other appointments include GENE DROSSEL, in charge of press relations, and JOSEPH J. TERNES, assistant to the director of public relations, in charge of the Los Angeles PR office.

DON S. PERMAR has been named to the newly created post of field sales manager of the Le Roi division of Westinghouse Air Brake Co. in Milwaukee.

L. O. CALKINS, formerly manager of project coordination in Los Angeles, has been put in charge of the newly opened Denver, Colo. district sales office of the Fluor Corp. Ltd. WILLIAM BOWLES will serve as district sales engineer.

B. E. Francis
Northern

L. O. Calkins
Fluor

BYRON E. FRANCIS, who has been with Northern Natural Gas Co. since 1939, has been named chief engineer, succeeding the late MARTIN C. MADSEN.

Pipeline Coating & Engineering Co. has added to its staff in Houston. BEN A. HUGHES is office manager, A. F. VOGLER is sales engineer, and D. E. HUGHES is district representative.

The Barrett division of the Allied Chemical & Dye Corp., New York, has appointed C. G. STUPP to the position of vice president. He will continue to head technical activities of the division. JAMES E. SAYRE has been named manager of the division's marketing research department.

DONALD S. DAY has been appointed to the newly created position of assistant general traffic manager of the Youngstown (Ohio) Sheet & Tube Co.

DR. WILLIAM FIRESTONE has been appointed to the newly created position of assistant chief engineer of the research department of Motorola's Communications and Electronics division.

JOHN A. MORGAN has been elected vice president of Glass Fibers Inc., Toledo, and appointed general manager of the western division.

GAS

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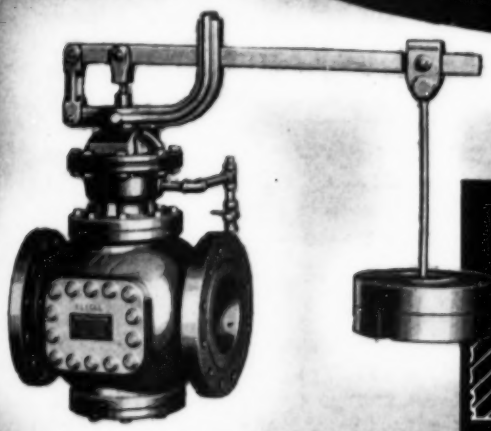

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NOTE: Valve Travel may be adjusted without disturbing the regulator or the gas flow by loosening locknut (N. R. 2072) and adjusting stem (N. R. 2075) to desired height.

The height may be calculated accurately by counting the 16 pitch threads from the bottom of the nut, R-2072, which allows the customer to get almost a micro-adjusting stem.

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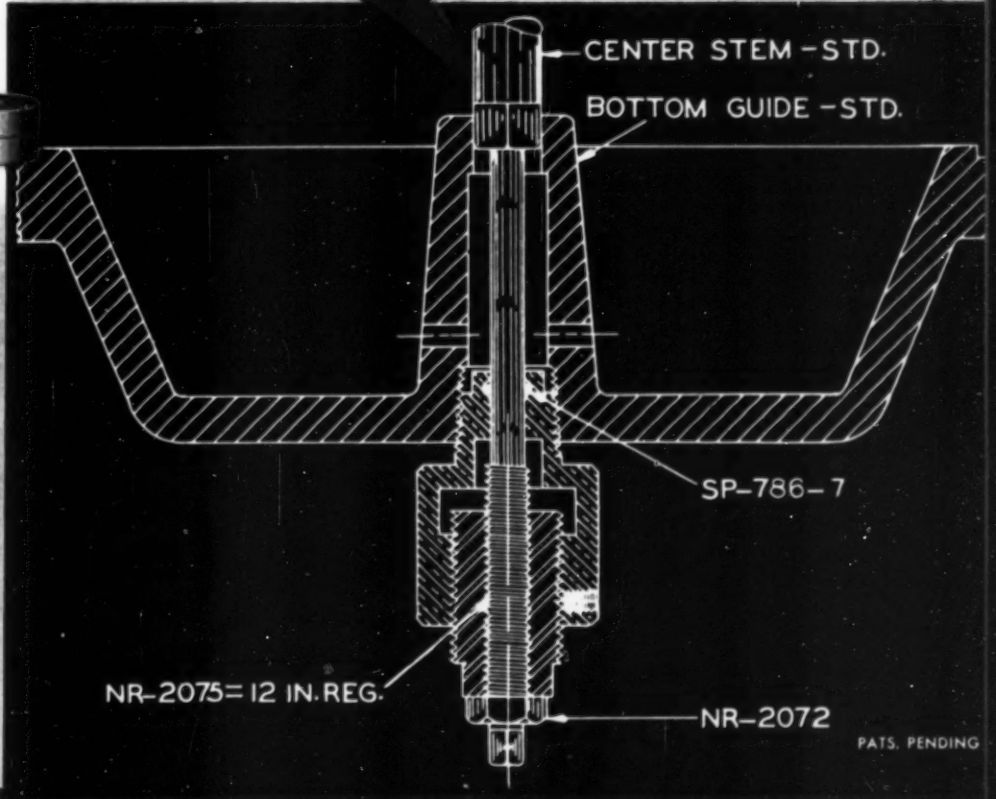

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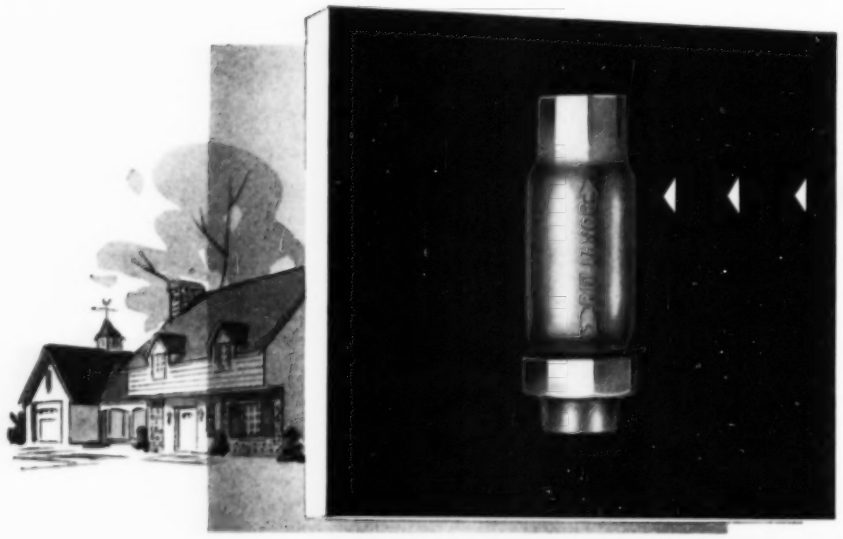
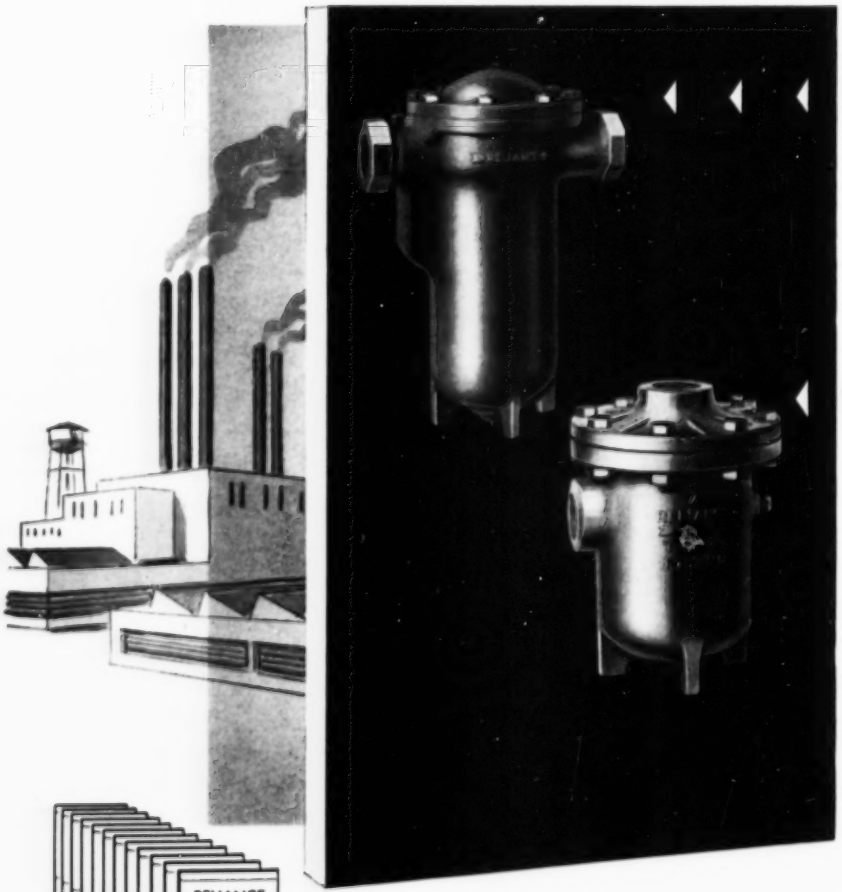
Reliance Filters Protect Home and Industrial Equipment When Converting from Manufactured to Natural Gas





Reliance Bulletin 35C gives complete specifications. Write for your free copy today.

Here are three types of Reliance Filters to protect meters, regulators and gas appliances from impurities such as dust, dirt and scale.

TYPE "B" FILTER

This filter is used extensively with individual appliances such as water heaters, ranges, furnaces, etc., and is recommended for general use on house service lines in dust areas of the distribution system. It will protect the regulator, meter and house piping from dust, dirt, scale, etc. that prove so expensive in operation and maintenance. It is made with ¾" or 1" standard pipe connections. Replacement of filter elements, when necessary, can be made on the job. Filter may be in a horizontal or vertical position.

TYPE "C" FILTER

This high capacity filter is recommended for use on distribution and industrial services where larger volumes occur. The screwed type connections and the Series 15 flanged connections are suggested for working pressures up to 150 p.s.i. The Series 30 flanged unit is used for working pressures up to 300 p.s.i.

TYPE "D" FILTER

For normal industries use where comparatively large volumes occur, this new filter is highly recommended. The L-shaped flow allows cap to be changed for a 1¼" to 2" screw type connection. This filter is designed to handle working pressures up to 150 p.s.i. It contains 5 filter elements as compared to 9 for Type 'C'.

All Reliance Filters are made from special high tensile strength grey cast iron, developed in our own foundry and proven over a number of years. Interchangeability of individual elements has been maintained as much as possible. For dust-free gas, install Reliance Filters on your service lines.

AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1836)

RELIANCE REGULATOR DIVISION
ALHAMBRA, CALIFORNIA

No Guesswork for Transco

This Great $200 Million Pipe Line uses many Cutler-Hammer Calorimeters to establish conclusively the B.t.u. content of gas gathered and sold

B.t.u.'s are the basis of the vast potential demand that moved the guiding genius of the Transcontinental Gas Pipe Line Corporation first to plan and then to build a $200 million pipe line from the great producing fields of the southwest to the doors of New York City. Since it is B.t.u.'s in and B.t.u.'s out that will pay back this huge investment, Transco has installed Cutler-Hammer Calorimeters at gathering points and at distribution points to establish conclusively the B.t.u. content of the gas gathered and sold. The C-H Calorimeter is the only instrument that literally counts the B.t.u.'s per cubic foot regardless of pressure, temperature or flow variables and with guaranteed accuracy.

And because their markets and their franchises depend on delivering to the consumer a stable, dependable, unvarying heating value per cubic foot, the municipal utilities served by Transco use Cutler-Hammer Gas Mixing Equipment. Cutler-Hammer Calorimixers for high pressure or low pressure gas, and Jet-type mixing equipment automatically bring and hold the mixed gas to a stable, unvarying figure by a process involving B.t.u. counting and flow control. Both metering and mixing equipment are available for any type of plant and any volume of flow. CUTLER-HAMMER, Inc., 1468 St. Paul Avenue, Milwaukee 1, Wisconsin.

C-H B.t.u. Control Equipment used on this system

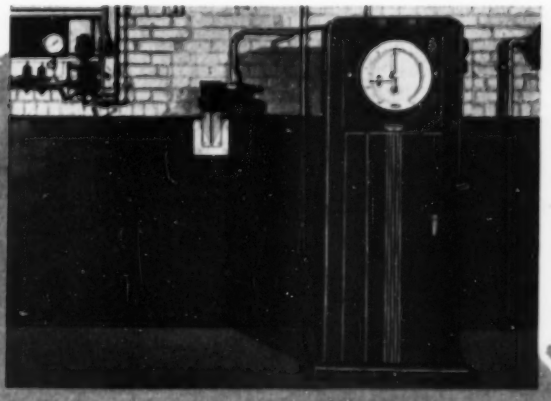
Transco uses Cutler-Hammer Calorimeters at gathering and distribution points to measure the B.t.u. content of the gas gathered and sold.

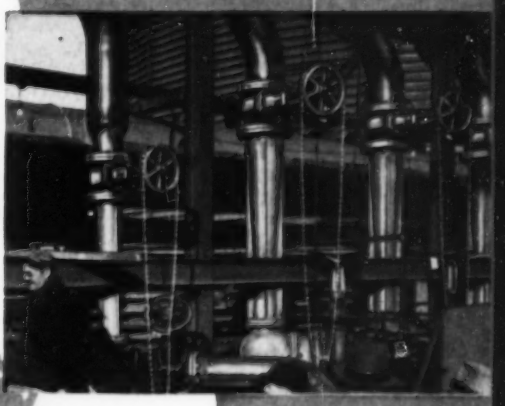
The municipalities served by Transco use C-H Calorimeters, Calorimixers and Jet-type mixing equipment to check, mix and stabilize the heating value of the gas distributed. Typical C-H installations are found in

Philadelphia
Elizabethtown
New York
Brooklyn
Camden
Jersey City

and many other municipalities along the way.

And the Municipal Utilities served use Cutler-Hammer Calorimeters to check, and Cutler-Hammer Gas Mixing Equipment to stabilize, the heating value of the gas distributed.





C-H Calorimeters *(at left)* measure accurately and uncompromisingly the B.t.u. content of each unit volume of gas distributed regardless of temperature, pressure or flow variables, and write a continuous, available record.

C-H Calorimixers *(in center)* automatically mix two or more high or low pressure gases of variable heating value in any volume, holding the final product undeviatingly to a stipulated figure.

CUTLER-HAMMER
B.t.u. CONTROL
C-H

C-H Jet type mixers *(at right)* automatically mix gases of variable heating value to a final low pressure stabilized value. When mixing directly into gas mains as well as into holders, they automatically adjust production to widely varying demands.

GAS

31ST YEAR OF PUBLICATION

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